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REPORTS

ON

FOREST MANAGEMENT

IN

GERMANY, AUSTRIA, AND GREAT BRITAIN,

BY

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WITH

EXTRACTS from REPORTS by MR. GUSTAV MANN, MR. ROSS, and MR. T. W. WEBBER;

AND A

MEMORANDUM by D. BRANDIS, Ph. D., Inspector General of Forests to the Government of India, on the Professional Studies of Forest Officers on Leave.

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PREFACE.

THE reports which are collected in this volume have been printed by order of Her Majesty's Secretary of State for India in Council, at the recommendation of the undersigned. In 1866 arrangements were made to enable forest officers, who come to Europe during their furlough, to increase their professional knowledge by studying forest management and other subjects connected with forestry in this country and on the continent of Europe. A number of officers have availed themselves of these arrangements, and it appeared desirable to publish a selection of such of the Reports received as seemed likely to prove useful to others who may follow their example.

It is a matter of regret that no reports of a similar character, by officers who had studied in the State and Communal Forests of France, could be included in this volume. A number of foresters from different parts of India have had the privilege of studying forestry in France; they have been received with the greatest kindness; every assistance has been shown them, and they have derived great benefit from their studies. The want of their reports, which were not available, the undersigned has endeavoured to supplement by a few remarks on the main points to which the attention of forest officers studying in France should principally be directed. These remarks will be found in a memorandum at the end of the volume.

At first sight it may seem a somewhat bold and fanciful idea, to expect forest officers from India to profit by studying forestry in Europe under a climate totally different, and in forests composed of other kinds of trees; but actual experience has shown that the professional knowledge acquired in European forests is of great practical use in India. There is hardly a question or difficulty of importance which arises

in connexion with forest administration in India, whether in regard to forest rights, or the working or the regeneration and improvement of the forests, which has not been dealt with practically over and over again by foresters in Europe. It is not too much to say, that no important steps should be taken in Indian forest administration without first ascertaining what has been done, or what ought to have been done, under analogous circumstances in Europe. And whatever progress has been made in Indian forest management, that progress is due to a great extent to the lessons we have learnt in the public and private forests of Europe. Much of what Indian foresters learn in Europe may not at once appear to be practically applicable to India, but so it is with all branches of knowledge. If we were to limit our studies to those subjects of which we see the immediate use for practical purposes, our progress would be poor, and our views would remain narrow and one-sided.

D. Brandis.

I.

Report on State Forests and Forest Management in Germany and Austria. By Captain Campbell Walker, Staff Corps, Deputy Conservator of Forests, Madras. Dated 1st October 1872.

My tour of inspection on the continent extended over four months and a half, of which I spent the first nine weeks in the province of Hanover, making myself acquainted with the system of forestry pursued in all its details, and the remaining period in visiting the forests of other countries, acquiring a knowledge of their extent, situation, and yield, the general plan of management and administration, the establishments found necessary for their organization, and their respective duties. Introductory.

I visited the forest academies at Neustadt-Eberswalde (Prussian), Tharandt (Saxon), Aschaffenburg (Bavarian), and Mariabrunn (Austrian), and saw some of the most interesting and characteristic forests of each State, and of those belonging to the Prince of Furstenberg in the Black Forest.

The time at my disposal did not permit my attending a course of lectures at one of the forest academies as recommended in Dr. Brandis' Memorandum for the Guidance of Forest Officers. I have no doubt I should have derived great benefit from doing so, but as the term extends over five months it would have prolonged my tour to eight or nine months, a longer period than I could afford to devote to the subject.

The system and general management in Hanover may be considered as typical, and the forests of that province are admitted throughout Germany to be well managed under the supervision of Forest Director Burckhardt, assisted by a numerous and well trained staff. For this reason, and as I am more intimately acquainted with the Hanoverian forests than with those of any other State, I devote the main portion of this report to a description of the science and administration of forestry as there understood and carried out, and confine myself with regard to the other countries to a brief statistical record, and allusion to any points which appeared to me particularly noteworthy, or in which they differ widely

from the Hanoverian plan or mode of procedure. To describe *all* that I saw would be impossible within the limits of any ordinary report, and entail much unnecessary repetition, so I do not attempt it.

My best thanks are due to Herr Burckhardt "Forstdirektor," in Hanover; Herr Judeich "Ober-forstrath," in Saxony; the Baron Chummecky, Chief of the Austrian Agricultural Department, and "Forstrath" Tchuppitch, in Vienna; "Ober-forstrath" Roth, in Donaueschingen; and to all the forest officers whose acquaintance I had the honour of making, for the pains which they took, and the anxiety they evinced to enable me to see and understand as much as possible during my tour. The interest evinced by all the German forest officers in the progress of forestry in India was also very gratifying and encouraging.

HANOVER.

The forests of Hanover under State management extend over an area of 1,435,329 Prussian *morgen*, equal to upwards of 900,000 English acres. (The Prussian morgen is ·63093 of the English acre, the old Hanoverian morgen being ·6477 of the English acre.) This extent is classed as— Area and classification.

a. 937,673 morgen Government Forest (591,000 English acres).

b. 53,806 morgen ecclesiastical or "Kloster" forests now secularised (34,000 English acres).

c. 261,116 morgen Communal forests (165,000 English acres).

d. 182,734 morgen Government moors and peat mosses (115,000 English acres).

The forests under class *a* are entirely the property of the State, although burdened in many cases with communal or individual rights and servitudes; those under *b* were formerly church property, now secularised by Act, and are managed by the Forest Department on behalf of the special department or board appointed for their administration. The profits are mainly devoted to educational and charitable purposes.

Class *c* are Communal Forests under Government management in accordance with the provisions of an Act which provides that they shall be managed entirely by the Government officers, but that the surplus annual yield of wood shall be entirely the property of the community, to devote to their own purposes or sell as they may think best. The community pay one groschen ($1\frac{1}{3}$*d.*) per morgen towards the pay of the officers in charge, unless the forest is of sufficient extent to justify the employment of a special officer, in which case they are debited with the total amount of his pay and allowances as well as with the disbursements for subordinate establishments and working charges.

Under class *d* are included extensive waste tracts, which in many cases are now being gradually planted with Scotch fir, and a considerable area of peat-bog or moss.

The annual yield of the forests during the four years from 1859 to 1863 inclusive was nearly 45 millions of cubic feet (of which about 10 millions of cubic feet were handed over to persons having rights and privileges) representing an Yield.

average yield per morgen of the cultivable area of about 37, and of the area actually covered with forest of 40 cubic feet per annum.

In the tables from which this information is taken the average yield of the hill forests is shown as much higher than that of those in the plains, the former yielding from 52 to 64 cubic feet per morgen, whilst the latter did not average more than 30.

Receipts and disbursements.

Director Burckhardt gives me the annual receipts from the Government Forests at two millions of thalers, or 300,000*l.*, whilst the annual disbursements during the years 1859 to 1863 amounted to thalers 455,138 for working charges, and th. 390,688 for establishments, pensions, land tax, &c., making a total of th. 846,426, say 128,000*l.*, and a nett surplus revenue of 162,000*l.*

These figures must not, however, be taken as perfectly accurate. The fullest information is given in Burckhardt's "Forstliche Verhältnisse des Konigreichs Hannover" (published in 1864), section VIII. pp. 69 to 99; but, as there pointed out, it is difficult to separate some of the charges, as the Harz Forests were until recently worked separately, and payments on account of mines, post roads, &c., included in the forest budgets, whilst the contributions of communities towards the payment of fixed establishments introduce an element of complication, especially in the case of communal forests with no actual cash receipts, or where these fall below the total amount of disbursements. Again the annual value, of grazing, forest products, &c., is estimated at thalers 741,420, or 108,213*l.*, but only a tithe of this sum is actually collected and credited in the accounts, the rest being free to all or to the inhabitants of certain villages in the neighbourhood of the forests.

The charges include considerable sums paid in commutation of rights and servitudes, and for forest surveys and valuations (*Massenaufnahmen*), which will gradually diminish.

Establishments.

Hanover being now, and since the year 1866, a province of the kingdom of Prussia, the forest establishments are gradually being remodelled and organised on the Prussian system, the leading characteristics of which are strong control and supervision.

The head office of the department for the whole kingdom is, of course, in Berlin, where it forms part of the finance department, which is divided into three heads or sections: I. Direct taxes; II. Crown lands; III. Forests.

The Forest establishments of the province of Hanover consist of 1 *Forstdirektor* and *Ober-forstmeister*, who is also a

councillor, 20 *Forstmeisters* in charge of circles or divisions, forming also a committee or board of management and reference in all forest matters; 112 *Oberförsters* in charge of forest districts (*Revier*) averaging 11,000 morgen each, 403 Foresters who assist the Oberförsters, and have charge of portions of a revier; 343 overseers, under-foresters, &c., employed in watching and protecting the forests and supervising the work which is executed by hired, weekly, or daily labour, or on contract under supervision of the fixed establishments. A "*Forstrendant*" or cash keeper is attached to each *Oberforsterei*, who receives and disburses all moneys in and from the forest cash chest, with which the Oberförster has nothing to do, although his accounts of sales, &c., should of course tally with those of the Forstrendant. For payment of labourers, &c., he gives orders on the forest cash chest, which are paid by the Forstrendant, whose books and cash balances are examined periodically by the Forstmeister in charge of the division, and accounts rendered to the head office of account in Hanover, and thence to Berlin.

In order to understand more clearly the position and nature of the duties appertaining to each grade or class of officials, it is necessary to bear in mind that the forests have all been surveyed, valued, and divided into blocks, and that there are accurate maps or plans representing not only the extent and situation of each forest district, but, by the use of different colours and shades of colouring, the description and age of the timber growing in each block or sub-division.

Valuation surveys.

It appears advisable to describe briefly how this is effected, and the valuations (*Massenaufnahmen*) and plans maintained and renewed so as to form always reliable data for information and guidance.

Besides the employés already enumerated, there exists an office and numerous staff for the sole purpose of measuring, valuing, and forming working plans for the forests. This is called the "Einrichtungs Bureau," and the work carried on by it is perfectly distinct from that of the ordinary forest management and administration. In fact all preliminary arrangements and settlements are worked out in this office, and when complete and sanctioned by the Forst Direktor are carried out by the executive under the supervision of the Forstmeisters. The office consists of a superintendent (Vorstand), draughtsmen, and clerks, generally practical foresters, and a staff of surveyors (Geometer) and forest valuators (Taxator), who are as a rule candidates for the position of Oberforster.

When a forest is (or more properly speaking *was*) about to be taken in hand and worked systematically, a surveyor

and valuator are despatched to the spot, the former working under the directions of the latter, who places himself in communication with the local forest officer and inhabitants interested, and obtains from them all the information in his power. The surveyor first surveys the whole district or tract, then the several blocks or subdivisions, as pointed out by the valuator, who defines them according to the description and age of the timber now standing, the situation, nature of soil, climate, and any other conditions affecting the rate of growth and nature of the crop which it may be advisable to grow in future years. Whilst the surveyor is engaged in demarcating and surveying these blocks the valuator is employed in making valuations of the standing crop, calculating the annual rate of growth, inquiring into and forming a register of rights and servitudes with a view to their commutation, considering the best plan for working the forest for the future, the roads which it will be necessary to construct for the transport of timber; in fact all the conditions of the forest which will enable him to prepare a detailed plan for future management (Einrichtungs plan), and the subordinate plans and instructions (Wirtschafts pläne, &c.) for a term of years, to be handed over to the executive officer as his "standing orders."

A complete code of rules for the guidance of the valuators has been drawn up and printed, in which every possible contingency or difficulty is taken into consideration and provided for.

Having obtained all the information which he can on the spot, and ascertained the views and wishes of the inhabitants of the surrounding villages having rights or privileges in the forest, the valuator and surveyor return to head-quarters, and proceed to prepare the working plan, maps, &c., from their notes and measurements.

When these are completed they are submitted by the superintendent of the bureau to the board or committee composed, as already stated, of the forstmeisters, and presided over by the Forst-Direktor and other councillors of the Finance Department, who examine the plan in all its details, and are prepared to listen to any objections which may be made on the part of communities or individuals. These are, however, I am informed, very rare nowadays, as the people have learnt that the action of the Government officers is not antagonistic to their interests, and are as a rule willing to allow them to settle matters to the best advantage.

The labours of the commission were formerly much greater than now when they consist almost entirely in ex-

amining and revising the working plan submitted for their approval with regard to its merits as a part of the system of scientific forest management and conservancy. If palpable errors in calculation of yield, rate of growth, nature of the soil, are detected, or the measurements found to be inaccurate (a very small margin for error is allowed), the valuator may be ordered to do the work all over again without remuneration, for it should be stated that the valuator, surveyor, and, indeed, most of the officials of the "*Einrichtungs-Bureau*," are paid only when actually employed on any particular work, being at the same time enrolled as candidates or probationers for the post of "*Oberförster*" or "*Förster*." As a rule the calculations and plans based on them are correct, having been thoroughly checked and overhauled in the office, and if all is approved they are made out in triplicate and signed by the Forst-Direktor and Forstmeister of the division, one copy being sent to the executive officer for his guidance, another retained by the Forstmeister, and the original at the head-quarter office for reference.

The "*Preface*" to the working plan contains a short history of the forest, its capabilities, requirements of the neighbourhood, &c. A sample of the headings into which it is divided is given at page 64, although no arbitrary rule or form appears to be laid down, and they vary according to circumstances and the views of the officers who prepare them.

The executive officer has thus in his hands accurate maps, on a large scale, showing each division and subdivision of the forest tract placed under his charge, and instructions for its management down to the minutest detail, the quantity to be felled annually, the extent planted, the state in which the forest should be found 10, 20, or even 100 years after the plans were drawn up; all these are calculated and laid down so that any change in the executive in no way interferes with the progress of operations, for all that the *Oberforster* has to do is to carry out the instructions given him, a margin being of course allowed for his discretion, and every allowance made for deviations from the working plan on account of natural and unforeseen causes, such as failure of seed, occurrence of storms by which thousands of trees are sometimes levelled to the ground, and the routine or systematic management interfered with for years, as the establishments are employed in working up and removing the fallen trees.

Duties of Forstmeisters and Oberförsters.

The *Forstmeisters* have no executive work, their duties being confined to the supervision and control of from four to six *Oberförstereien* or *Reviere* (vide Note, page 65); in

fact they may be considered as occupying a position analogous to our deputy conservators, whilst the *Oberförsters* may be classed as assistants.

Our deputies and assistants in India have often been employed on exactly similar duties, but such is never the case here, where the control and even, as we have seen, the demarcation, valuation surveys, and preparation of working plans are kept perfectly distinct from the local executive, whose business it is to carry out the carefully digested plans and orders received from the controlling branch. Other systems have been tried but none have been found to work so well as this, which combines the advantages of efficient administration and supervision by officers who have themselves gone through the executive grade and who are individually and collectively qualified to organise and supervise the work of others, with the concentration of the energies of the local officer on his own charge with the object of carrying out to the best of his ability the orders he receives without troubling him or diverting his attention by making him responsible for the general plan of operations which forms part of that which is considered most applicable and beneficial for the whole nation or province.

The Forstmeisters make frequent inspections of the several districts in their division (Bezirk) and thoroughly supervise the work of the Oberforsters and their subordinates both in the forest and office work, reporting on the same to the Direktor. The Oberforsters submit annual reports comparing operations actually carried on with those prescribed in the working plans, and giving reasons for any material divergence from them. They spend the greater portion of their time in the forest supervising the felling, planting, sowing, thinning, carting, and selling of timber. The laying down of roads is generally entrusted to one or more forest officers with special qualifications or aptitude for that work, but the actual work is carried out by the local officer. He has also a considerable amount of office work, issuing of licenses for grazing, &c., and preparation of reports, returns, and accounts; but his duties may be considered as mainly out of door in comparison with those of the Forstmeister, who has more office work, comparing the result of operations and the rates in the several districts, collecting information and statistics for future guidance, settling disputes and affording advice and assistance to his subordinates, and, as a member of the forest commission or committee, considering and revising working plans submitted from the "Einrichtungs Bureau."

The main object aimed at in any system of scientific forestry is, in the first instance, the conversion of any tract or tracts of natural forest, which generally contain trees of all ages and descriptions, young and old, good and bad, growing too thickly in one place and too thinly in another, into what is termed a "*geschlossener Bestand*" (closed or compact forest), consisting of trees of the better descriptions and of the same age or period, divided into blocks, and capable of being worked—*i.e.*, thinned out, felled, and reproduced or replanted—in rotation, a block or part of a block being taken in hand each year. In settling and carrying out such a system important considerations and complications present themselves, such as the relation of the particular block, district, or division to the whole forest system of the province; the requirements of the people, not only as regards timber and firewood, but straw, litter, and leaves for manure, and pasturage; the geological and chemical formations and properties of the soil; and the situation as regards the prevailing winds, on which the felling must always depend, in order to decrease the chances of damage to a minimum; measures of precaution against fires, the ravages of destructive insects, trespass, damage, or theft by men and cattle; all these must be taken into consideration and borne in mind at each successive stage.

The aim of scientific forestry.

Nor must it be supposed that when once an indigenous forest has been mapped, valued, and working plans prepared, the necessity for attending to all such considerations is at an end. On the contrary, it is found necessary to have a revision of the working plan every 10 or 20 years, when new maps are prepared showing the progress made towards the objects laid down in the original scheme, and although it is marvellous how generally the plan of operations is found to have answered and been adhered to on the whole, still the necessity of modifications and alterations of system do more or less present themselves. It may be found advisable to change the crop as in agriculture, to convert a hard wood into a coniferous forest or vice versâ, to replace oak by beech, or to plant up (*unterbau*) the former with spruce or beech to cover the ground and keep down the growth of grass. All these and a hundred other details are constantly presenting themselves for consideration and settlement, and the local officer should be ever on the alert to detect the necessity of any change and bring it to notice, no less than the controlling branch should be prepared to suggest what is best to be done, and conversant with what had been done and with what results under similar circumstances in other districts and provinces.

Having thus given a general outline of the duties of the forest employés, and how the forest is first "taken up," divided, mapped, valued, and plans laid down for its future management, I shall state briefly what I saw of the practical working and how the actual forest operations are carried on.

Districts visited.

I visited 12 districts or reviers with Director Burckhardt or one of the forest officers, and went thoroughly into the details of management, the various methods of planting and sowing (artificial and natural), treatment of young trees in the nursery, thinning, removal of undergrowth, "*unterbau*" or planting up, felling, conversion of timber trees into logs or billets, removal from the forest, piling or stacking, and sales by auction; and whilst thus engaged in seeing operations in progress endeavoured to master the details of the system and general plan of operations by the study of books on forestry, in which Germany is very rich, rules and regulations for the guidance of the forest officers and subordinates, working plans, &c., &c.

As I spent most of my time in the reviers of Springe and Lauterberg-am-Harz, I shall confine my remarks mainly to these districts.

Springe Revier.

The Springe Revier is situated in the neighbourhood of the town of Hanover, from which it is reached by diligence in three hours (a railway has just been opened). The forest, which includes an extensive game preserve known as the "*Sau-Park*," may be considered as in the plains although it ascends and clothes the sides of a low range of hills. The *Oberförsterei* is extensive, covering an area of some 19,000 morgen, or about 12,000 acres, mainly covered with oak and beech forest. Favoured by situation and depth of soil, the formation is mostly oolitic limestone and sandstone, the growth in this revier would be exceptionally good were it not for the damage done by the deer and wild pigs, which is very great, so much so that it has been found necessary to fence off the portions being cleared to allow of natural reproduction taking place.

Natural reproduction.

As this plan of natural reproduction forms one of the most important points in the German system of forestry, it appears as well to describe here how it is conducted.

It has been already stated that the *Umtrieb*, or rotation of crop and periods into which it is divided, are fixed in the working plan. The usual *Umtrieb* for beech hoch-wald in Hanover is 120 years, divided into six periods of 20 years each, that is to say, when the forest has been brought into proper order there should be as nearly as possible equal areas under crop in each of the six periods, viz., from one year to 20, from 20 to 40, and so on. It is not imperatively neces-

sary that the total extent in each period should be together; there may be 500 acres in one place and 50 in another, but it is advisable to group them as much as possible and work each tract regularly in succession, having regard to the direction of the prevailing winds, which do incalculable damage if once allowed to get into a forest by injudicious felling on the windward side. When a block arrives in the last period felling is commenced by what is called a *Vorbereitung* or *Besamungs-schlag* (preparatory or seed-clearing), which is very slight and scarcely to be distinguished from the ordinary thinning carried on in the former periods. This is followed by a *Licht-schlag* (clearing for light) in the first year after seed has fallen (the beech seeds every fourth or fifth year) with the object of, 1st, preparing the ground to receive the seed; 2nd, allowing it to germinate; and, 3rd, affording sufficient light to the young seedlings. The finest trees are, as a rule, left standing with the two-fold object of depositing the seed and sheltering the young trees as they come up. If there is a good seed year and sufficient rain the ground should be thickly covered with seedlings within two or three years after the first clearing, but it is generally found advisable to wait for a second seed year and aid nature by hand sowing, transplanting from patches where the seedlings have come up very thickly to the barer spots, and turning up the turf, and so giving the seeds a better chance of germinating (*vide* Report on Lord Seafield's woods), page 96.

When the ground is pretty well covered the old trees are felled and carefully removed, so as to do as little damage as possible to the new crop, and the block recommences life, so to speak, nothing further being done until the first thinning.

The time allowed to elapse between the preparatory and the final clearing naturally varies much, according to situation and circumstances. In Hanover it rarely exceeds 15, and is often as little as 8 years, but there would appear to be a growing tendency in other provinces to do away with this system of so called "*Kahlabtrieb*," and remove the old trees so gradually that there can scarcely be said to be any clearing at all, the new crop being well advanced before the last of the parent trees is removed. This new system finds much favour in the Black Forest, as will be explained hereafter. At Springe the woods in the first period, where the final felling was going on when I was there, had, as I have stated, been fenced off so as to exclude the deer and pigs, and the natural reproduction had been particularly good, the hill slopes being thickly covered with seedlings;

but a new and formidable enemy had presented itself in the shape of field mice, which nibble round the bark just above the surface of the ground. Thousands of seedlings had thus been destroyed, and as fast as blanks were filled up by transplanting the young trees were attacked and killed. I left the Oberforster in despair at the wholesale destruction which was thus going on, and which, with all the knowledge and appliances of modern forestry at his command, he was powerless to prevent; but I have no doubt a sufficient stock will, after all, be left, supplemented by a little transplanting from the nurseries, which are well stocked.

The deer do great damage in the older beech woods by stripping the bark from the trees. These have then to be felled within a year or eighteen months, which interferes with thinning operations in other localities, and precludes any regularity in carrying on operations and bringing the forest into proper order. These beech thinnings are cut into billets and piled ready for sale as firewood. The price realised is only about 4*s.* 2*d.* per cubic metre, say, 1¼*d.* per cubic foot, which is very low.

I inspected tracts containing oak, beech, &c. representing all the periods, and compared the growth as recommended by Dr. Brandis. There are some very fine beech woods in the second and third periods, but to my eye they required thinning, having fully double the number of trees to the acre which would be left in England. This, however, I afterwards found universal in German forests as compared with those I have seen in England and Scotland, and forms a vexed question on which much has been said and written on either side, too much to be summarized in this report; probably a happy medium would be found to be the best, and the peculiar circumstances of climate must always have much to say in such matters.

Presence of grass in plantations.

It may, however, be stated with reference to the remarks regarding pasturage in my report on the Scotch forests, page 107, that the presence of grass in plantations or young woods is throughout Germany considered as a sure sign of a faulty system of treatment, and consequently more or less unhealthy state of the trees. It is mainly with the object of preventing this that oak woods are planted up with beech, which grows well under shade and covers the ground so as to exclude the light, which, if admitted, must produce a growth of grass or herbage. The conditions under which the oak grows best being tersely expressed in German "*Kopf frei boden bedeckt*" (Anglicè, Crown free soil covered or sheltered). I have, however, seen grass growing in English

plantations which were very thick, and into which little or no light could penetrate, and am inclined to think that our moist sea climate has as much to do with it as the greater distance from tree to tree and the absence of "*Unterbau.*" There is no doubt that the droppings from some descriptions of trees, particularly the larch, are very favourable to the growth of grass both before and after the trees are felled, as they produce a rich and fertile humus; and, although I am inclined to agree with the Germans that but little or no grass or herbage should be found in plantations in Europe, its presence in our Indian plantations does little or no harm to the trees, as it tends to keep the soil moist and shelter it from the fierce rays of the sun, and that in any case the immense advantage of increasing the supply of green fodder by having the grass cut during the first few years and cattle admitted after the trees are past harm's way, more than counterbalances any negative damage to the trees or sacrifice in annual growth. In short, the presence of grass is no evil in itself, and the forester must never lose sight of the necessity of getting the ground in his plantations under cover in order to keep the soil loose, and enable the atmospheric air to penetrate to the roots. This appears all important. Of course, in mature or nearly mature forests, whether planted or indigenous, little or no grass should ever be found.

With regard to the *Unterbau* or planting up and rearing of two crops at the same time, the general opinion of English forest officers is antagonistic, and I myself thought it impossible without more or less detriment to both, and great damage to the young growth in removing the old crop; but I am now convinced, from what I have seen, that it is not only practicable and easily carried out by the exercise of a little ordinary care, but is, as a rule, highly beneficial and deserving of being introduced, at least in a tentative manner, in England, and certainly in India, where we have, as in Germany, to provide a supply of firewood as well as building timber. I am convinced that if we can find the proper trees to grow under shade a great step will be made in our Indian forestry, and our plantations prove much more healthy and remunerative than hitherto. In this I am sure all our officers who have seen and studied the German system will agree, and where the undergrowth is for firewood and not to be reared as timber, the difficulty, small as it is, of removing the old crop is obviated by the *Unterbau* being removed first; in fact, it is probably cleared four or five times before the timber crop matures. As regards

"Unterbau."

England, there is the difficulty that there would be little or no demand for the beech as firewood, and it is of little value for any other purpose; but I am inclined to think that such a demand will arise if the price of coal continues to increase, and that even if the planting up of oak woods can be made to pay its expenses a great point will be gained in the improvement in quality and more rapid growth of the oak; for it must be borne in mind that the main object of beech or spruce under oaks or Scotch firs, &c. is to cover the ground, to the importance of which I have just alluded, and not to produce firewood.

Planting out of hard wood.

During my stay at Springe I saw also a good deal of planting out of hard wood trees from the nurseries, and in this respect also there is a good deal of difference from what is usual in England. In Hanover the seedlings are transferred at the age of from two to four years from the seed beds into the "*Schule*" or nursery, where they are trained, pruned, and transplanted as often as required until finally planted out, which is sometimes not done till they are 12 or even 14 years old. So far the treatment does not vary much from that adopted in our nurseries in England, save that I think trees are rarely with us planted out so late, excepting for ornamental purposes, avenues, or other quite exceptional cases. Here we find the planting out of 10 to 12 and even 14 year old trees (called *Heisters*) the rule, and they are almost invariably put out without any nurses, although these may be and generally are added a few years later in the shape of coniferæ of four or five years old planted between the rows or beech *Unterbau.* I do not mean that young hard woods are never planted out at five or six years of age, but it is exceptional; and in no case that I have seen or heard of were nurses planted with the trees as with us, still less before the hard woods, as in the New Forest.

The oak and beech *Heisters* after, say, 10 years schooling are lifted, the branches carefully pruned into, as nearly as possible, a pyramidal form; the roots trimmed and shortened, the more woody parts being even sawn off, and only the fibrous rootlets left, and the trees then planted out in pits which are dug just large enough to receive them. The distance apart at which they are planted varies according to situation from eight to twelve feet.

Planting out of such large trees is naturally rather expensive, but I was told it ought not to average more than 1½*d.* each, all expenses included, which seems very low, considering that two men cannot plant more than 100 a day (including, of course, the digging of the pits), and that

the cart hire from the nursery to the plantation site is expensive.

The absence of nurses struck me as very remarkable and deserving of attention, and I have since found it universal throughout Germany; in fact, the German foresters could not understand how we can manage with nurses (especially spruce, Scotch fir, or larch, which grow so rapidly at first) of the same age as the hard woods. Absence of nurses.

They often plant spruce some years subsequently, and point out that even then it generally overtakes the hard woods, and has to be cut down, which they do immediately its head shows above that of the oak or beech, and again and again if necessary before they (the spruces) are finally removed. I am not competent to express an opinion as to which system is correct, but both cannot be, and I must say I cannot recall an instance of damage done to hard woods in Germany by the absence of nurses, whilst I have seen them injuriously crowded and their growth impeded by their presence in England.

I brought my stay at Springe to a close by an interesting visit to the Communal forest belonging to the town, and managed by a subordinate forest officer paid by the community, but who works entirely under the orders of the Government forest officers. One portion of the beech forest was particularly interesting, in which he was clearing and encouraging reproduction very gradually and carefully, as there was great danger, owing to the situation, of too much light being admitted, which acting on a very rich soil, would result in a very rank growth of grass and weeds sufficient to choke the seedlings. The result appeared very good, and does credit to the intelligence of the *Revierförster*. Communal forest.

The timber from this forest is taken by the burghers, each of whom is entitled to a certain annual quantity, and it is the duty of the forest officer in charge to supply this quantity and still retain the forest in good state—no easy task.

Beyond this, however, he has nothing to do with the burghers, who have no say in the management or working of the forest, nor can they alienate nor clear for cultivation any portion, although it is exclusively their property, and the State derives no benefit from it beyond the preservation of the timber and clothing the hill sides, which is considered, even in this temperate climate, a matter of paramount importance. The burghers cut up and cart away their allotments of timber at their own cost, and are free to dispose of or retain it for their own use as they may think best.

Some such system might, I think, be adopted with advantage in India for the management and preservation of our village forests.

Lauterberg Revier.

The Lauterberg Revier is situated on the lower slopes of the Harz mountains, and is 15,000 morgen (about 9,400 English acres) in extent. The geological formation is of the Silurian period, consisting mainly of clayslate, and grauwacke, and the soil is formed from the decomposition of the underlying rock more or less mixed with vegetable mould. The low-lying portions of the revier are covered with beech forests, which, as one ascends, give place to spruce intermixed with Scotch fir, and here and there a little larch. There is but little oak in the revier, but a good deal of hornbeam (*Carpinus Betulus*) interspersed with the beech.

The revier is particularly interesting and instructive from the opportunities it presents of observing the growth and treatment of both hardwood and coniferæ in the plains and on the hill sides. In fact almost every variety of treatment, sowing, planting, felling, and preparation may be met with and studied advantageously in this and the adjoining reviers in the Hanoverian Harz. The Oberförster, Herr Ohnesorge, is most painstaking, and ever anxious to explain and make things clear, which he is particularly well qualified to do, from his extensive and varied knowledge of forestry and the sciences connected with it. I have to thank him heartily for the trouble he took; to which I am mainly indebted for the insight I obtained into the details of German forest management and the object of each particular treatment or plan of operations. Several of our forest probationers have already benefited by his teaching, and all speak in the highest terms of his never-varying kindness and desire to get them on with their studies.

I spent three weeks on the revier along with Mr. Amery, a forest officer from the Punjâb. The forests are almost entirely Hochwald, and the annual growth or increase of wood is estimated at as high as 50 cubic feet per morgen (80 cubic feet per English acre), the umtrieb being 120 years (for beech). This annual increment represents a total yield during this period of 6,000 cubic feet per morgen, or upwards of 9,500 cubic feet per acre, which is a high average. It is estimated that from one-fourth to one-fifth of the total yield is removed by thinning, but this varies much according to description of tree and situation.

We visited with the Oberforster portions of the forest representing all the periods of growth; nurseries and schools

for seedlings; and witnessed planting being carried on in many different ways to suit the necessities of soil and situation; felling by the axe and with the crosscut saw; squaring of hard wood and barking of pine stems to facilitate removal from the forest; slipping in log and on sledges; in fact, every variety of forest operations; and I only wish some of our Indian overseers had been present to learn a few practical lessons and useful hints to be applied in our hill forests. The natural reproduction of hard wood is carried on in the same manner as described at Springe, but little or no damage is done here by game. The tracts of Scotch fir and spruce are generally replanted two or three years after being cleared, the roots having meanwhile been carefully dug up, and for the most part used for the manufacture of charcoal, which is extensively carried on.

Planting out of conifers.

The young trees (spruce and fir) are scarcely ever *slitted in* as in Scotland, but pitted and transplanted with a ball. This is naturally more expensive, but, coupled with the careful previous cleaning of the soil, prevents the ravages of the beetle, which was formerly a very deadly enemy here. In marshy ground a plan called *Hügel* or *hill* planting is often adopted, which consists in merely laying the young plant, which has been removed with a ball, on the top of the turf or spongy grass, and placing round it another turf removed from the adjoining ground (thus forming a mound, whence the name). This plan appears to answer well, and I saw many hundreds of acres which had been planted by it on the upper plateau, of the Harz.

There are many other methods of planting adopted, too numerous to detail here. The steepest and most rocky sides of the hills are covered with forests which have been, so to speak, created by the ingenuity and labours of the forest department. In many such places, where even the few handfuls of soil placed round the young tree have had to be carried some distance, it is not contended that the first plantations will yield a direct pecuniary profit, but the improvement in climate by retention of the moisture, and reclamation of large tracts formerly barren and unproductive, is taken into account, besides which the droppings of leaves and needles from the trees will ere long create a soil and vegetation, and ensure the success of plantations in future years, and consequent surplus.

Damage done by insects.

The Harz forests have from time to time suffered great damage from the attacks of insects, probably increased by the great dearth of small birds, which is most marked. Large sums have been expended in destroying the insects and

beetles, and of late years these have proved successful, and the damage been reduced to a minimum. The knowledge which German forest officers possess on this and kindred subjects is very great. The Oberforsters and even the Forsters and overseers can generally identify every beetle or insect met with in the forest, know whether it is destructive or harmless, and in the former case how it attacks the trees, and what measures are most effective in preventing or checking its ravages.

We visited several other reviers in the neighbourhood of Lauterberg, and thus obtained a good general idea of the forests of the Harz mountains, the portion of which situated in the province of Hanover extends over 204,000 morgen, and yielded, according to the forest budgets of 1864 to 1866, an annual surplus revenue of thalers 316,057, or about 4*s.* per morgen of the planted area, after deducting all charges for establishment, working, land tax, &c. Four-fifths of the forest area is spruce, and the remainder for the most part beech hochwald. The department maintained in 1864 270 miles (English) of forest roads in the Harz, and 480 miles throughout the whole province; and great attention is paid in each revier to the important matter of communications, without which the finest forest becomes comparatively worthless save in so far as it affects the general welfare of the country.

Saw mills.

In the adjoining revier to Lauterberg is a fine saw mill (water power), erected some years ago at a cost of 3,750*l.* The wheel drives one large rough-toothed saw (vertical) for quartering large beams, and eight vertical frame saws for planking. The system adopted is to debit the mill with all timber handed over to the manager at fixed rates, whilst he takes credit for the amount of sales to merchants. The balance and value of work performed by the mill is thus clearly shown, and the accounts of the executive officer remain clear and uncomplicated. I was informed that the results were generally favourable, but the department do not now have many mills in their own hands, and purpose selling this one; as competition has sprung up, and it is better if such operations as working up of timber can be carried on efficiently by private enterprise. All the departmental officers with whom I conversed concur, however, in stating that the saw mills, of which the State had formerly a large number, were a necessity, and have contributed greatly to the financial success of the department. I think we may gather a lesson from this for our guidance in India, where we cannot as yet expect private enterprise to erect and work

saw mills when and where required. We must set the example, and show the natives how to do it, saving at the same time a great deal of the waste of timber which now goes on, and must be felt sooner or later, only abandoning the mills and allowing them to pass into private hands, when we see that private enterprise and competition is sufficient to guarantee the carrying on the work in an efficient manner, and so as to supply the people with what they require without the evils of a monopoly.

Servitudes

The Lauterberg revier, and many of those bordering, so to speak, on the cultivated area in the plains, are much burdened with servitudes, which reduce the actual cash profits to a very small sum. These rights or servitudes are all clearly defined and registered, and when, as is the case for the most part, they consist of timber for the erection of houses or firewood, it is the duty of the executive forest officer to supply the privileged parties with the quantities to which they are entitled at the time and place laid down. Should he, however, find or imagine that the demand from this source exceeds the supply or annual yield, or that the forest is being worked actually at a loss, it is his duty to bring the circumstances at once to the notice of the Forstmeister, with a statement of the reasons which induce him to do so. The matter would then receive attention, and, if necessary, a complete revision and revaluing or stock-taking would be made. Should the local officer's view be found to be correct the rights of the villagers would be curtailed, or even suspended altogether for a term of years, the conservancy of the forest for the general good being considered paramount to all individual or class interests or privileges, even when the latter are of long standing.

Of course this rarely happens, but instances have been known owing to bad or injudicious management, failure of natural reproduction, damage by storms and insects, &c. &c.

A trip to the "*Kloster*" forests at Ilfeld with the Forstmeister brought our stay in the Harz to a close. These have for the most part been treated as *Mittelwald*, but a considerable portion is now in process of transformation into *Hochwald*. It struck me both here and in the Mittelwald at Rothenberg revier that too many standard trees were as a rule left over, and that the coppice was in consequence poor and rarely attained any size. The proportion of trees to be left over in this description of forest is laid down as 12 *Baüme*, or trees of the oldest class; 18 *Oberständer*, trees of medium age; and 30 *Lasreidel*, or saplings left from the last clearing—60 trees in all, equivalent to 80 to our English

acre, in addition to the coppice. The length of rotation varies from 20 to 30 years, and the coppice is estimated to produce 20 cubic feet per morgen per annum, whilst the standard trees as above should, under favourable circumstances, exhibit an annual increase of from 30 to 35 cubic feet per morgen.

Oak coppice.

The oak coppices which I subsequently visited with the *Forst-direktor* appeared very well managed, and yield a large profit. The young oaks are "schooled" for two years, then cut over and planted out, after which they are coppiced for the bark every 16 years; the young wood of other sorts, such as birch, ash, hazel, &c. which may have sprung up having previously been cleared out, along with any oak shoots of no value for barking, and sold as firewood.

Excursions.

The last ten days of my stay in Hanover were devoted to the study and making extracts of working plans and short expeditions to reviers in the neighbourhood with the Forst Direktor and some of our forest students then in Hanover.

During these trips we tested and put in practice the various methods prescribed for estimating and valuing the quantity of timber on a measured area, the various instruments for measuring height and girth and ascertaining the annual rate of growth.

The most accurate information has been collected and statistical tables compiled by Herr Burckhardt with regard to the rate of growth, effects of thinning, comparative value of hardwood and coniferous plantations, methods of computing cubical contents of standing timber, annual increase, and many other kindred subjects. It would be impossible to give here even a very abridged statement of the results arrived at, and the same would not of course apply to India or even to England; still a study of the method in which the inquiries have been pursued and results deduced from the data acquired is very instructive, and should serve as a guide for similar researches in India, where they are much needed.

In the neighbourhood of Celle I had an opportunity of witnessing the method adopted for planting the fir successfully in moorpan or iron-band, extensive tracts of which have lain waste for centuries, and defied all the efforts of the forester. They are now gradually being covered with fine forests. The plan adopted is to plough, or, when necessary, trench with the spade to a depth of two feet or more, turning up the "iron-band" to the surface, where, in the course of one or two years it decomposes and becomes a most excellent and congenial soil for the growth of the Scotch fir.

The fine communal forest of *Eilenried* was also visited and its management explained. This forest may be said to environ the town of Hanover, and contains some of the finest oak trees which I saw in Germany. It affords a most charming public recreation ground, whilst at the same time producing a good revenue. Director Burckhardt also took us to a revier where the so-called *Plänter-betrieb* or *Wirthschaft* was still to be seen. This method of treatment approximates to what we are doing or have been trying to do in our Madras forests, and I believe in India generally, *i.e.*, merely to fell trees of the better descriptions as they arrive at maturity. It is generally condemned throughout Germany as, unless most carefully managed with numerous and well-considered restrictions, it must lead sooner or later to a paucity of mature trees to produce seed, and hence to a deterioration in quality of the young crop, and eventually to the extinction or destruction of the more valuable descriptions by others more hardy, and saved from the axe by their comparative worthlessness.

"Plänter-betrieb."

The method adopted for the transformation of such tracts into regular plantations or forests is very instructive, consisting in gradually thinning out the less valuable sorts or white wood and encouraging the growth of thick clumps or groves of those which it is wished to retain, which gradually reproduce themselves, and eventually, aided by artificial sowing or planting where required, cover the ground and constitute a close and regular forest.

It would not do to condemn the plänter-betrieb entirely for India, as, within certain limits, it has its advantages, but there is no doubt that we should at least experiment as above, and favour the more valuable timber trees at the expense of the inferior descriptions. Some idea of this did present itself to Mr. A. J. Stuart, sub-collector of Tinnevelly, early in 1871, and proposals on the subject were under consideration when I came home.

PRUSSIA.

Area and classification.

Out of a total area of nearly 35 million hectars, Prussia has upwards of 8 million hectars classed as forest. (The hectar may be computed as 2½ English acres, the exact relation being 2·4711431.)

Of this, however, 53 per cent., or upwards of 4 millions of hectars, consists of private forests, and the remainder, with which we have more immediately to do, is divided into

a. State forests	-	2,486,598	hectars.
b. Communal forests	-	1,246,965	,,
c. Ecclesiastical ,,	-	69,825	,,
Total	-	3,803,388	,,

Equal to 9,508,470 English acres, or close upon 15,000 square miles; and of the area of State forests (upwards of 6,200,000 English acres) only a fraction over 4 per cent. is classed as waste or unproductive, although 10 per cent. is devoted to other purposes, which include the sites of forest houses and buildings, gardens, pasture lands allotted to the forest employés, &c., &c. The yield for 1871 of this great extent of woodland, the greater proportion of which (1⅓ million hectars, 3⅓ million English acres) consists of Scotch fir, pure or mixed, is estimated at 5,688,785 "*fest metres*," or 204,796,260 cubic feet, representing a yield of 2·4 *fest metres* of wood per hectar, or 34·5 cubic feet per English acre of the area actually devoted to the production of timber.

Yield.

This yield may appear small in comparison with that of other States, but the figures are taken from *Bernhardt's Forststatistik*, one of the most recent and reliable publications. I am, however, inclined to think that the apparent great difference is in some measure explained by more accurate returns for Prussia than some of the other States, and from the average yield being rigidly calculated on the total area devoted to the growth of timber whether actually stocked or not, whilst other states compute it on the area under or capable of producing timber only. A considerable extent of the area classed as *forest* in Prussia must consist of moors and barren wastes only now being actually planted up. I have endeavoured to explain this more clearly in the Remarks on the tabular statement given at page 68, in

which the average yield per English acre in several States is exhibited.

The money value or cash receipts by the sales of timber and firewood is 12⅓ million of thalers (about 15*s.* per hectar), to which, however, has to be added upwards of a million and a half of thalers for forest products and miscellaneous receipts, raising the total income from the Government forests to close on 14 millions of thalers (2,100,000*l.*). Receipts and disbursements.

The disbursements, which are divided into ordinary and extraordinary, amount to 7½ million of thalers, leaving 6½ million thalers, or little short of a million sterling, as the actual profit for the year. When it is considered that this result is arrived at without trenching on the capital or stock of timber in the forests, which, on the contrary, is being increased and improved in every province of the kingdom, and that the indirect value to the people of many forest privileges, which they exercise free of charge, must be very great, not to mention the benefit to all in the shape of public recreation grounds and improved climate, some idea may be arrived at of the enormous value and benefit of a system of state forests and forest management as matured and worked out in Prussia. The ordinary expenditure includes pay of the forest establishments, all ordinary working charges, cost of the forest academies at Neustadt and Münden, and expenses connected with the preservation of the game, and other sporting charges, all of which are managed in Prussia and Germany generally by the Forest Department.

Under extraordinary expenditure are classed commutation of rights and servitudes (for which 75,000*l.* is allotted), purchase of land, contribution to public highways (as distinct from forest roads, which are provided for under ordinary expenditure), and supplemental charges for cultivation and the forest academy at Münden.

The forests, as already stated in the Report on the Hanoverian forests, form part of the finance or revenue department, and are presided over by an "*Oberland-forstmeister*" and "*Ministerial direktor,*" aided by a revenue councillor and joint "*Ministerial direktor*" and a numerous council or board, with suitable office establishments and secretaries for the various branches. Establishments.

The forest academies are at Neustadt Eberswald near Berlin, and Münden, in the province of Hanover (formerly the Hanoverian forest academy).

The *Oberland-forstmeister* is curator or governor of the academies, and at the head of each is an "*Ober-forstmeister,*" who is aided by a numerous staff of professors and assistant professors.

There is also a special control office of account, or accountant general for forests, at Potsdam, where all the forest accounts of the several provinces are finally checked and audited before going in to the general ministry of finance.

The 12 provinces of Prussia, several of which represent kingdoms of a few years ago, are divided into 30 circles (*Regierungsbezirk*), and to each of these an "*Ober-forstmeister*" (who may be classed as a conservator with us in India) is appointed to represent the forest department in the council of local administration (*Regierung*), and aided by councillors, and, as we have seen in Hanover, by the *Forstmeisters*, as a board, to represent forest interests in the government, and administer the department to the best advantage. Next in order come the *Forstmeisters* (corresponding to our deputy conservators), numbering 108, in charge of divisions with an average area of 25,000 hectars, and then the executive officers, 706 *Oberförsters*, with charges averaging about 3,000 hectars, to each of which is attached a *Forstrendant*, or collector of forest revenue, and 3,646 *Försters* (or overseers), with ranges of from 500 to 1,000 hectars. The respective duties of all grades have been detailed in the portion of this report devoted to Hanover, which province is included in the foregoing statement of the area, yield, &c., of the Prussian forests.

Forest academy at Neustadt-Eberswalde.

I visited the Forest Academy at Neustadt-Eberswalde, and had a most interesting conversation with the director, "*Herr Ober-forstmeister*" Danckelmann, on various subjects connected with forestry in Europe and India. He is assisted by a staff of seven professors with assistants, and there is an experimental garden attached to the academy, with *Oberförster* Bernhardt in charge of the strictly technical portion, and other gentlemen for the meteorological, zoological, and chemical sections. The number of students at the academy averages 65. Oberförster Bernhardt kindly accompanied me round the gardens, and pointed out everything of interest, including a building where the seed is dried and separated from the cones, known as a "*Sammendarre*," extensive seed beds of spruce and fir sown in parallel lines with the help of boards specially adapted for the purpose, which ensure regularity and the seed being all at the same depth; seed beds of willow, and treatment of the seedlings when transplanted; and examples of trees of every description for botanical study, including many of the rarer descriptions for the more advanced students.

Professor Dr. Altum, the successor of the well known entomologist Ratzeburg, author of a large work on insects destructive to trees and timber, accompanied me through the

museum, which is rich in specimens of all sorts of birds, animals, and insects found in the forests, very neatly arranged. In cases where the animal or insect does damage to trees, specimens of the branch, bark, leaf, root, or cone in a healthy state and after being attacked are exhibited close to each, so that the student can see at a glance the nature of the damage and connect it with the animal which causes it. Thus we have squirrels, rats, beavers, mice, set up to represent nature, gnawing the bark, grubbing at the roots, &c., &c. Insects are shown in the several stages of their existence, larvæ, chrysalis, caterpillar, moth, with their ramifications in the stem or branches of the tree. These, with specimen blocks of almost all descriptions of timber, form a most instructive and interesting collection, in which much time could be spent with advantage.

Time did not admit of my visiting the forest revier attached to the academy, which is chiefly remarkable for the growth of Scotch fir and spruce in the face of great natural difficulties, on a poor sandy soil and repeated ravages of the beetle.

There is a similar academy at Münden, which I did not visit, with about the same number of students.

Qualification and nature of studies required from forest candidates.

Nothing struck me as more remarkable than the extent and varied nature of the studies required from forest candidates or probationers in Prussia, and the number of years they are content to spend, first in studying and then in waiting for an appointment. The would-be Oberforster, which is the lowest of what we would call the "gazetted appointments," must, after passing certain terms at a Government school of the first class, spend a year with an "Oberforster" in a revier, and then pass an examination as forest pupil, after which there is a two years' course at a forest academy and an examination in scientific forestry, land surveying, &c., on passing which the pupil becomes a "*Forst-kandidat*"; then another two years' practical study, during at least nine months of which he must actually perform the duties of a forester, after which comes the final Government examination, on passing which he enters the grade of *Oberforster-kandidat.* The difference betwixt the two examinations is explained to be that the first tests the candidate's knowledge of theoretical forestry and cognate sciences, whilst the latter tests his ability to apply what he has learnt and capability for employment as Oberforster and in the higher grades.

After passing the final examination the "Oberforster-kandidat" is employed as an assistant in the academies and

control offices, in making forest surveys, and working plans, and sometimes acting in charge of a revier, receiving certain daily or weekly allowances whilst so employed. After five or six years of this probation he may look forward to being permanently appointed.

Thus we have at least five years spent in study and another five in probation; the former without any pay, and the latter only with meagre allowances, whilst actually employed, before the would-be forest officer is installed; and the time is generally much longer. Yet so great is the desire for Government service, and particularly forest service, in Prussia, and indeed in Germany generally, that there is no lack of competitors.

A certain proportion (one-third) of the Oberforster's appointments in the old Prussian provinces is given to members of a military institution, founded by Frederick the Great, known as the mounted *Feldjäger Corps*, whose duties correspond somewhat with those of our Queen's messengers, but are mainly intended for use in the time of war.

Unless in very exceptional cases the oberforster is not promoted to the higher grades unless he has undergone a further two years' curriculum at a university and passed two examinations, known as "Regierungs and Forst Referendariats Examen" and "Assessor Examen," but, if I mistake not, these can be studied for and passed during the time of probation as Oberforster-kandidat. The qualifications for admission into the subordinate grades, such as forester, subforester, and overseer, which are included under what is called the "Forst Schutzdienst," or forest conservancy, or protective establishments, have, like most things in Prussia, a military tendency. Candidates, after a two-years' practical course in the forests, enter a Jäger battalion, and bind themselves for 12 years' service. In case of good behaviour they are allowed to pass the Jäger's examination after one year's service, before a forest officer, but it is not clear to me what they gain by this. After an average of three years' service they obtain leave, and are employed in the forests as "Hülfsjäger," or assistant huntsmen or gamekeepers. After eight years they must have passed the foresters' test, which consists in a six months' probation as a forester or overseer, in charge of a tract of forest, and an oral and written examination. On the expiration of the 12 years' term of service they receive their final discharge from the Jäger corps and certificate entitling them to employment according to seniority in the forest conservancy establishments. The appointments are much sought after, and for the year 1867 there were 221 certified candidates for 145 vacancies; but

many are absorbed by employment in communal and private forests, and doubtless the war has since thinned the ranks of the Jäger corps, and put an end to the aspirations of many a would-be forester by death or wounds.

Forest law

Owing to the rapid growth and development of the Prussian kingdom of late years, there cannot be said to be any forest act or code of forest laws for the whole kingdom. Each province has still its own forest act or regulations, and it will probably be found very difficult to introduce one general code, although I have little doubt, from what I know of the Prussian character and love of uniformity and order, that it will be done ere long. In some provinces the Government has a certain legal status and *say* with regard to the management of communal and even private forests; in others it has none. It would serve no purpose to detail here the exact state of things in this respect.

I visited no forests in Prussia with the exception of those in Hanover, but have thought it right to enter into this brief statistical notice considering the vast area and yield of the forests and the excellence of the system under which they are administered.

I am mainly indebted for a knowledge of what I have here described to notes made during my visit to Neustadt-Eberswalde and "Bernhardt's Forst Statistik Deutschland," a work recently published in Berlin, and containing much valuable information.

SAXONY.

Area and classification.

The State forests of the kingdom of Saxony extend over an area of 288,133 Saxon acres, 394,165 English acres (one Saxon acre = 1·368 English), of which only 11,414 acres are classed as not under timber. The average annual yield of the forests, from 1864 to 1868 inclusive, was 340,878 *klafters*, representing 1·23 *klafter* (98·5 cubic feet) per Saxon acre of the area actually under crop (*vide* remarks at page 70). This quantity realised 2,329,450 thalers, (say, 350,000*l.*). The average annual expenditure, during the same period, amounted to thalers 672,923 (say, 101,000*l.*) leaving a nett profit of thalers 1,656,533 (249,000*l.*) per annum, representing a clear yield, or rental, per Saxon acre of thalers 5·75, or 17*s.* 3*d.* (say, 12*s.* 6*d.* per English acre).

Yield.

Receipts and disbursements.

The expenditure is divided into 1, *onera realia*; 2, improvements and repairs, which include planting, draining, construction of roads, and improvement of unproductive tracts; 3, working charges, including cost of felling and transport of timber, destruction of insects, daily wages, &c.; 4, fixed establishments. An average area of 4,297 Saxon acres was planted yearly, during the period of five years to which these statistics refer, at an average cost per Saxon acre of about 13½ thalers, or about 30*s.* per English acre; but it must be borne in mind that this includes the cost of planting avenues, filling up hard wood plantations with conifers, as shelter for the ground, and in particular replanting in the deer park at Moritzburg, where the cost in some instances reached 26·65 thalers per acre.

Area planted or sown annually.

Establishments.

The forests are divided into fourteen circles or divisions, containing 131 reviers or districts, being an average of nine to each division. The area of the divisions varies according to situation, accessibility, &c. from 17,500 to 47,500 English acres. The fixed establishment consists of one inspector (Oberland-forstmeister), who is also a councillor in the finance department; 15 Ober-forstmeisters, *i.e.*, 14 in charge of the several divisions, and one in charge of the control (*Einrichtung*) office; 120 ober and revier forsters in charge of the several districts (11, which are of small extent, are in charge of foresters), 16 collectors or receivers of forest revenue, 13 forest engineers, 27 foresters, and 83 sub-foresters. The forest academy at Tharandt has a separate staff of professors, with Herr Judeich as director.

The duties of the respective employés do not differ materially from those of the corresponding grades in Hanover,

X in which districts -

the Oberland-forstmeister and Ober-forstmeisters forming the control and supervising branch, the Oberforsters and Revierforsters, aided by the foresters and sub-foresters, the executive, whilst the forest engineers are employed in surveying, &c., and the "*Forstrent-beamte*" as paymasters or accountants. All ranks are provided with house accommodation, or granted an allowance in lieu thereof.

I spent some days at Tharandt, and visited the Tharandt revier (3,000 acres) with Professor Greifenhahn, and the Spechshausen and Grillenburg reviers with Oberforst Rath Judeich. Great damage occurred in all these reviers by very high winds in 1866 and 1868, when whole tracts were blown down, the loftiest beech and spruce trees being uprooted and thrown down pell-mell. The establishments are still occupied in converting and transporting this timber, and, as a natural consequence, other work, such as thinning and felling, in other portions of the forest is in arrears. In fact, the whole course of operations has been interrupted, and it is impossible to carry out the plans as laid down beforehand. One most serious result of such disasters is that, the whole tract being levelled at once, little or no natural reproduction takes place, and the whole has to be replanted artificially. In other portions of these reviers they are experimenting with a system of "*vor verjüngung*," or reproduction prior to felling, in opposition to the ordinary "*nach verjüngung*." Seed is sown, and the growth of the young trees to form the next crop encouraged, before any, or when only a small portion of the old crop is cleared, and by the time the old trees are entirely removed the young crop should already cover the ground, and be several feet high. The system promises well, and does not differ much from the very gradual clearing of mature tracts in the Rippoldsau forests (*vide* page 49). Tharandt.

I was present at a forest excursion of the students at the academy (who number 60, including three Englishmen, probationers for the Indian forest department). Oberforst rath Judeich and the other professors explained the various methods of felling, working up, estimating height and contents of trees, &c., and the same were practically illustrated on the spot, the requisite instruments having been sent out beforehand. The whole was very interesting and instructive. I specially noticed a very good and simple apparatus for marking and numbering logs, of which we stand so much in need in Madras, and Herr Judeich kindly had one made for me, which I shall take with me on my return.

I also visited, by Herr Judeich's advice, the forest reviers Wernsdorf and Luppa, in the Wernsdorf division near Wernsdorf and Luppa Reviers.

Leipsig. The Oberforstmeister there was kind enough to accompany me round the forests in person, along with the Oberforster. The Wernsdorf revier is particularly interesting, as it has been, and is still in process of being converted from a hard wood into a pine forest. In 1820 almost the whole area was covered by a mixed hard wood forest, consisting of oak intermixed with beech, birch, alder, &c., patchy and irregular, the soil being impoverished, and requiring a change of crop. It was then decided to convert the whole gradually into a coniferous forest, and maps were drawn showing its existing condition, and what it should be after 80 years. It is marvellous how systematically and regularly the plan has been carried out. Fifty years have now elapsed, and there are coloured maps or plans made every 10 years, which show clearly the gradual change to its present state, and by 1900, unless some unforeseen and unpreventable occurrence takes place, the ideal chart, made in 1821, will represent almost exactly the age and description of timber in each portion of the revier. In accordance with the plan also, private lands, which abutted on the forest, and in some instances intersected it more or less, have been bought up from time to time and planted, so that in place of a straggling wood, irregularly covered with timber trees of inferior growth, we have now a compact close forest, regularly wooded in sections of different ages, principally with spruce and Scotch fir, but containing also fine oak, ash, and beech, with straight and clean stems.

In many cases the young oaks have been left in clearing away the beech, alder, &c., in order to plant or sow pines; and the result of the introduction of the latter has had a wonderfully beneficial effect in the growth and healthy appearance of the trees, which are now fair specimens, standing in the midst of coniferous plantations, with their crowns free, and stem and trunk protected. The young oak plantations are particularly fine; in fact, I do not think I have seen so good elsewhere. I would strongly recommend a visit to this revier to any of our officers visiting Saxony. It is most instructive, as showing the advantages of systematic and scientific forestry, based on plans well considered and matured by the estimating and controlling branch, and carefully carried out by successive executive officers. The increase in value of the revier (which has an area of 2,000 hectars) must be very great. Ober-forstmeister Brunsi and Oberforster von Brandenstein spared no pains or trouble to ensure my seeing the forests and thoroughly understanding the conditions; and I am sure they will be equally obliging and

attentive to anyone who may follow in my footsteps. The forest is about five miles distant from the Luppa Dahling station on the Leipsig and Dresden railway.

Absence of communal or private rights, a noteworthy feature.

Perhaps the most noteworthy feature of the Saxon State forests is the absence of all communal or private rights, or servitudes. This very desirable state of things has been arrived at by the application of the procedure, laid down by the Forest Act of 1832, prior to the passing of which the forests were burdened in all directions by servitudes, often vague and ill-defined, and forming a never ending source of dispute and bad feeling betwixt the forest officers of the Crown and the people who had, or considered they had rights in the forest. In the great majority of cases, cash payments have been the means adopted to compensate the commoners; and, although the sums awarded appeared at the time heavy, and were, I am told, very liberal, the State has gained not only in a pecuniary sense from being better able to control and consolidate the forests, but, in the general welfare, increased value in stock or capital of timber, and the cessation of disputes and ever increasing claims.

I am aware that there are objections to such a settlement by payments to the existing representatives of a right in which they have only a life-interest; but, after all, the money, or what it procures in the shape of better houses, improved cultivation, &c. descends to future generations, for whose benefit and that of the public in general the forests are also maintained and improved in a manner which can never be equalled when they are encumbered by rights to pasturage, wood, turf, &c.

I cannot explain how the existing state of things in this important respect has been brought about, better than by submitting a short *précis* of the Act, for the translation of which I am mainly indebted to Mr. D'A. Vincent, one of our forest students at Tharandt.

The Commutation of Rights and Servitudes in Saxony.

Précis of the Forest Act of 1832 for the commutation of rights and servitudes.

The law which provides for the abolition of all servitudes is dated March 17, 1832. But, before going into it fully, the act or mandate of 1813, of which it forms an important part, should be studied. This mandate, dated July 30, 1813, was a forerunner to the act of 1832, and, in a certain measure cleared the way for it. The first paragraph says "that as "the real and essential object of woodlands is the production "of wood, the secondary products (*Nebennutzungen*) must "be so curtailed as not to interfere with the primary and

" chief product (*Hauptnutzung*)." The secondary products named are grazing, pasture, collecting of leaves, grass, and litter, juices of the trees and berries, and other fruits. The commoner is therefore bound to agree to any such arrangements as the owner may make for preventing the abuse of the rights, and any disadvantageous effect on the condition of the woodlands.

Paragraph 5 provides that the rights of the commoner shall be restricted to his own personal and domestic wants, so that no trades can be carried on in the products he draws from the woods.

By paragraph 7, no young plantation is to be opened for grazing till the plants are out of the reach of damage from the cattle, and, in those newly opened, cattle are not to be driven till the 24th of June, as before that time harm might be done to the young plants.

The succeeding paragraphs provide for the commoner's rights. " If common land is to be enclosed for a time for " planting, pasture of equal quality and quantity must be " provided for the commoner; if one or more com- " moners dispose of their rights, a proportional part of " common land can be divided off; the number of cattle to " be pastured is to be decided by the number the commoner " keeps in winter, and in cases of dispute three farmers are " to decide, one appointed by each party and one by the " government."

This mandate having in some measure restricted the demands of the commoners, the Act of 1832 was passed, by which it was decreed that after January 1, 1833, any servitudes or rights could be abolished or commuted, 1st, by mutual agreement; 2nd, at the demand of either party, lord of the manor, or commoner.

The various servitudes are classed as under:—

a. Various rights of grazing.

b. Forestal rights, viz., those of felling trees, collecting leaves, grass, and litter, and of tapping trees for turpentine.

c. The rights of cutting grass, reeds, and turf in the woods, as on other lands.

d. The rights of digging sand and loam, and of quarrying stone.

The commutation may be by payment of a lump sum of money, by an annuity, by division of land, or (in class *b.*) by a yearly quantity of wood. The lord of the manor may choose in which way the commutation shall be paid, and he may choose one or more different ways.

When this law treats of rights and servitudes to be commuted, it is only meant as far as anyone has exercised real right on the ground of another person, and does not treat of rights exercised by asking the owner's permission, or by revocable consent.

In cases when a community is lord of the manor, or has rights and servitudes to exercise, the act of commutation is to be by vote, the votes being counted and the funds raised in proportion to the voter's station and rank in the community. Any individual member of a community may, however, dispose of his rights without the concurrence of the rest of the community.

In the removal of mutual servitudes, servitudes on each side of equal services are not taken into account, the only item to be considered is the comparative magnitude of the one servitude.

On a petition being presented by either party for commutation, the first point to be ascertained is the extent of the servitudes. The cattle to be pastured are to be determined as in the mandate of 1813. If sand and loam are judged by the commissioners to be absolutely necessary for the commoner, the lord of the manor may restrict him to one part for digging the same.

In the commutation the damages which the commoner is to receive are to be assessed as follows :—If the lord of the manor petitions for commutation, the damages to be paid are what the regular exercise of the rights would bring; that is, what the commoner will lose by the falling away of the servitudes. If, however, the commoner petitions, the lord of the manor may select whether the damages are to be assessed as above, or according to the advantages which the land will gain by being freed of the servitudes.

The above is a summary of the chief paragraphs of the Act.

The method of working the Act is as follows. The matters to be decided come,

1st. Before a special commissioner.
2nd. Before a general commissioner.
3rd. Before the higher courts of law.
4th. Before the ministry.

A case for commutation comes, therefore, first before the special commission composed of two members, (1) a member of the bar qualified to act as actuary and judge, (2) a practical farmer, preference being given to those who own or farm large estates. This commission acts on the spot where the ground in question lies. The special commissions are appointed and directed by the general commissions.

The court of appeal above the special commission is that of the general commission, composed of two members of the bar and of two farmers, for the ordinary work, which consists in arranging the special commissions, &c. &c., but in cases of appeal the court is strengthened by two judges from the upper courts.

The last appeal can be made to the upper courts of law, except when complaints are made against the general commission or upper courts, when they are heard by the minister of the interior.

The parties concerned have to bear equally the expenses of the special commission (surveying the land, daily pay, and travelling expenses), and have also to provide free lodging when servitudes are to be commuted; when rights are commuted, the costs are apportioned to the parties by the commission.

In cases of appeal to the general commission, the court decides in each case whether the costs are to be borne by both parties, or by which side. In most cases the costs are borne by the State.

Another feature of the commutation in Saxony is what is called the *Landrentenbank*. This state bank issued mortgage bonds to the lords of the manor at 3½ per cent., so that they were enabled to pay the commoner at once. The bonds were to be gradually repaid, the capital of the bank being found by the State. The manor was therefore mortgaged to the extent of the bond issued. This appears to have worked very satisfactorily.

By the supplement to this Act, dated May 15, 1851, all servitudes and rights, for whose commutation no steps, up to January 1, 1854, have been taken, continue only as personal obligations on the lord of the manor and his heirs, as long as the land is not alienated. A petition for commutation must therefore be directed to the general commission before December 31, 1853, or the claims cannot be recognised.

In 1884 all personal obligations in this matter are extinguished. When the government buys private woods, it is customary to buy them only free of any servitudes, and the vendor pays off the servitudes, if any, with the purchase money (of course before 1884).

I am informed that the general commission and *Landrentenbank* were abolished soon after 1854, there being no further use for them.

BAVARIA.

On my arrival at Munich I was sorry to find that Herr Von Mantel, who had been so long at the head of the Bavarian Forest Department, and well known as one of the ablest and most experienced forest officers in Germany, had retired on a pension, and I did not thus have the benefit of his advice and assistance during my stay in that kingdom. Herr von Baldinger, one of the forest councillors, was acting in charge, and I found him most kind and attentive in giving me information, chalking out my route, &c., although, from not having previously had immediately to do with such matters, nor arranged a general plan with Dr. Brandis as Herr Von Mantel had done, he was naturally somewhat at a loss as to what districts would prove most instructive and best repay a visit by an Indian forester. We eventually settled upon two, besides Aschaffenburg and the Spessart, which I had pre-determined to visit after seeing something of the Black Forest.

Districts visited.

The districts selected were in the *Bayerische Wald* and *Schwaben*, and eventually the time at my disposal only permitted me to visit the latter, which I much regretted, as the Baierische Wald is particularly recommended by Dr. Brandis as deserving a visit, and cannot indeed fail to be interesting and instructive, as it still contains much indigenous or virgin hill forests, now being gradually brought under systematic management, and offers an opportunity of seeing how things are managed as to construction of rough hill roads and slips, transport of timber from the higher slopes, and floating in the valleys down the mountain streams and on the river Regen. I was, however, more reconciled to the loss of this opportunity by the information that, owing to the occurrence of frequent storms of wind, which had blown down many trees, the establishments were almost entirely employed in getting them out of the forests, to the detriment of any regular forest work, which might serve as a guide, and that I would have an opportunity of seeing floating and improvement of rivers to the best advantage in the Black Forest, which I afterwards found to be the case.

I may mention that Herr von Baldinger dissuaded me from visiting *Kranzberg*, between Munich and Freysing, and the *Haupt Moor*, at Bamberg, which are specially mentioned in Dr. Brandis' memorandum, as he said they did not now present any points of special interest such as could

be found in the Baierische Wald, the Bavarian Alps, and some parts of the province of Schwaben.

Area and classification.

The forests of Bavaria extend over an area of 7,622,045 *tagwerks*, equal to 6,417,685 English acres (a *tagwerk* is ·84199 of an English acre), but of this extent 3,709,624 tagwerks, or nearly 50 per cent., are private forests, leaving 3,294,219 English acres as the forest area under State management. This is classed as,—

a. Purely State Forests	- -	2,318,623 acres.
b. Communal ,,	- -	859,494 ,,
c. Ecclesiastical ,,	- -	116,102 ,,

263,159 acres are classed as unproductive, leaving in round numbers 3,000,000 English acres, covered with forests under the management of the Government forest department.

Yield.

It is difficult to arrive at the actual yield of timber, as it is divided or classified in a manner very difficult to explain in English, and which would occupy too much space here, and the measurement or method of estimating cubical contents varies according to class. The yield of the purely state forests may be roughly stated at upwards of 130,000,000 cubic feet, including faggots and stumps; and of this large quantity, upwards of 26,000,000 cubic feet may be classed as timber fit for building and similar uses. The average yield per English acre, including faggots, may be taken as 63 cubic feet.

Receipts and disbursements.

During the finance period extending from 1861 to 1867 the average annual cash receipts were close on 12,000,000 florins (1,071,428*l.*), whilst the ordinary expenditure classed under, (*a.*) establishments, (*b.*) working charges, (*c.*) planting, &c., (*d.*) construction of roads, amounted to close on 5,000,000 florins (446,428*l.*) and the extraordinary, which consisted of sums allotted out of the annual income, for, 1st, buying up or commutation of servitudes, and, 2nd, purchase of woods and plantations, is set down at 536,028 florins (47,859*l.*). These figures leave a clear sum of 6,676,471 florins, equal to 596,113*l.*, as the cash profit of the forest, to which is added the value of timber and firewood, grazing and other forest rights given free, estimated at upwards of 2,000,000 florins, leaving 8,819,779 florins, or 785,964*l.*, as the actual annual profit during the period under review. This represents close upon 4 florins (7*s.* 4*d.*) per tagwerk, and is an increase of fully a florin per tagwerk on the former period of seven years extending from 1856 to 1861, with which it is compared. This result must be very gratifying to the forest officers and all concerned.

An average extent of 35,000 tagwerks was planted or sown annually during the period under review, representing 37,000,000 of young plants, and 1,000,000 pounds of seed. I am unable to state the cost of the plantations, as it is mixed up with that of promoting natural reproduction, draining, &c., and there appears to be in some parts of the kingdom a system of "*socage*," or performance of work without cash payment, in consideration of certain privileges, which renders it difficult to arrive at a correct estimate of the expenditure. It is not without interest to note, that so recently as 1855 parties found guilty of breaches of forest rules were liable to be, and actually were, punished by enforced labour in the forests and plantations.

Area planted or sown annually.

During the period 1859–60 to 1866–67, 60,234 tagwerks were added to the area of the State forests, by purchase, costing 5½ million florins, and some 3,000 tagwerks by exchange; 9,155 tagwerks were sold to the public for upwards of 2½ millions of florins, or 286 florins per tagwerk. The purchases consisted mainly of pieces of land abutting on, or even running in between the forests, and their acquisition will facilitate better arrangements for conservancy, formation of the complexes, &c. The sales were for the most part detached pieces of land, more valuable for agriculture than the rearing of timber.

The area under wood in Bavaria in proportion to the total area and population is very great, representing 34 per cent. of the former, and 1½ tagwerk or upwards of an English acre per head of the latter.

During the two finance periods extending from 1853 to 1867, much appears to have been done towards the commutation and buying up of forest rights. In this most important matter nearly 6,000,000 of florins have been spent, and 13,000 tagwerks of forest ground given up; but for this the forest department has extinguished for ever 2,425 rights to building timber, 4,810 rights to firewood, 2,425 rights to straw and grass from the forests, 1,780 rights to grazing, and 301 miscellaneous rights. The rights to straw, litter, and grass are, perhaps, the most prejudicial of any (regarded from a forest officer's point of view), as they consisted not only of the right to remove the grass found growing in certain tracts, but also to prevent any planting, which might at any time cause a cessation or diminution in its growth.

Commutation of forest rights.

The Bavarian forest department forms, as in Prussia, a subdivision of the finance department, and is administered by a technical councillor and Oberland Forstmeister and three

forest councillors at the head-quarters of the ministry (Munich). Bavaria being divided into nine provinces, there is also a forest councillor at the head-quarters of each province, and, as a rule, two *Kreis Forstmeisters*, or inspectors, for each province. There are 74 divisions or circles, each with a Forstmeister aided by at least two assistants as supervising officers, 614 Oberforsters, and 1,622 foresters, sub-foresters, and overseers.

The *personel* of the department thus consists of one inspector-general and member of council, 12 councillors (three in the finance ministry and one for each province), one director and 4 professors at the forest academy, one librarian, 17 inspecting and 74 divisional Forstmeisters, 614 Oberforsters, 182 assistants to the Forstmeisters (including 32 employed in the head quarter and provincial offices), 624 foresters, 594 sub-foresters, and 401 overseers. Demarcation, survey, and valuation operations are, as a rule, performed by candidates or probationers for the post of oberforster, as in Prussia; and, in fact, the duties of all grades may be said to be analogous.

Forest academy at Aschaffenburg.

The forest academy is at Aschaffenburg, near the Spessart, and is presided over by a director, aided by four professors, and an assistant or teacher. There were 165 students when I visited the academy, a larger number than I found at any other, and consisting, I was informed, mainly of foreigners, which speaks volumes for the good repute of the Bavarian forest system.

The collection of specimens of timber struck me as being particularly good and well arranged. The specimens are almost all Bavarian, and for the most part collected from the various forests of the Spessart.

Districts visited.

I visited the *Sachsenried* and *Frankenhofen* reviers in the *Kaufbeuern* division of the province of Schwaben, and was much struck with the fine growth of spruce, which surpassed any I saw in Germany, the trees being of great height, and with clean straight stems.

The tagwerk (less than $\frac{4}{5}$ of our acre) is here estimated to produce an average of 100 cubic feet per annum, which is very high, but I can well believe it after a personal inspection of the reviers. Planting of land, recently acquired by purchase, was being carried on, chiefly spruce with a little silver fir. In one part they were trying sowing along with corn, the expense of preparing the land, sowing and clearing, after removal of the crop, being borne by the cultivator. The experiment promised well. A large percentage of these reviers is at present in the oldest period, with trees

100 years old and upwards, which renders it difficult to work them systematically.

The Oberforster was busy with a forest road, which he was constructing under the most adverse circumstances, the material in the neighbourhood being bad, and allotment small.

I was accompanied on this trip by the assistant to the divisional Forstmeister, who was himself engaged, having appointed to meet several parties on important business. The assistant proved a most efficient substitute, and, as well as the Oberforsters, appeared thoroughly to understand and take an interest in forestry in all its branches. I was struck by the excellence of the forest house where we had luncheon, and could only wish we had something similar in India. I intended to have accompanied the Forstmeister to a gathering of forest officers on the frontiers of Wurtemberg, to which he was kind enough to invite me, but the weather turned out so bad that I thought it better to proceed to Lindau, at the foot of the *Boden-see* (Lake of Constance), where I called on the Oberforster, but did not do more than casually walk through some of the plantations, as it happened to be a public holiday.

This revier is like those just mentioned, noted for the fine growth of spruce.

I next visited the reviers of Waldaschaff and Rothenbuch in the Spessart (province of Unterfranken). These reviers, with an area of 6,812 and 10,912 tagwerks respectively, consist mainly of hard wood forests, oak (chiefly the *Sessiliflora*) and the beech predominating, and are specially of interest from the fact that, notwithstanding a favourable soil and not unfavourable climate, the oak was at one time in great danger of disappearing altogether, giving place to the beech, and even less valuable trees, such as birch, aspen (*Populus tremula*), and that the main object during the past 100 years has been to encourage its growth and mitigate the damage done to some of the finest forests of the kingdom by mismanagement and neglect.

Space does not admit of the causes which led to the deterioration of the fine forests of the Spessart being detailed here; suffice it that they consisted mainly of the felling of the finest trees of the better descriptions as soon as, or even before, they arrived at maturity, impoverishment of the soil by the removal of grass and leaves, which otherwise would have produced a fine rich humus, and the presence of a dense mass of underwood, allowed to grow unchecked and unthinned. The so-called "*plänter betrieb*" was then in force, but even this was not worked out upon any principles of

selection or conservancy, and it would perhaps be more correct to say that there was no system at all, and that the best trees having been recklessly felled, those of the inferior descriptions got the upper hand and prevented any young oaks coming up, whilst they drained the soil already impoverished by the baring of the grass of all its substance, and gave nothing in return.

Early in the present century the matter attracted attention, and every means have since been adopted to favour the growth of the oak, mixed more or less with beech, and, where requisite, with coniferæ, to improve the soil and cover the ground.

The result of these measures is now becoming apparent, and although we must not yet expect to find that regularity in growth and uniform appearance which characterises the best managed forests in Germany, I believe that nowhere else could one meet with finer clumps, and individual trees than in the Rothenbuch revier. The finest oak trees are now being left standing during two or even three periods of rotation, to supply an abundance of seed, and the greatest care is taken to check the growth of inferior descriptions, which will soon be rarely found in the forest.

In some of the more remote portions, where the humus had not been disturbed or destroyed, the growth of the beech and oak is truly magnificent, tracts consisting of 120 to 140 years old beech, mixed with 300 to 400 years old oaks, being not uncommon, the latter with clean trunks running up to 100 feet in height. When we compare these with other portions where the crippled and stunted appearance of the trees shows the effects of unregulated grazing and removal of the grass, burning of the decayed wood and ashes, and forest theft and mischief on the soil and vegetation the result of mismanagement or even want of care and knowledge is most marked. The circumstances are in many respects analagous with what has gone on in India for centuries, and is still more or less permitted. The vast extent of forests, which once clothed the hill sides and extended far into the plains, and the more luxuriant growth of the tropics, have hitherto, or until within the last few years, prevented the gradual deterioration of our forests being marked or felt, but the subject has now luckily attracted attention, and none too soon. If any have doubts in the matter let them visit the Spessart, study the history of its forests, and judge for themselves.

The "*Schläge*" or clearings in the Rothenbuch revier appeared to me somewhat too large and clean, causing a

want of shade for the young crop, which was also in some cases much exposed to the wind.

From these causes, and doubtless also the impoverished state of the soil (which has rendered it imperative in some cases to replant entirely with coniferæ), the growth of the young crop, whether naturally reproduced or planted, is sometimes very slow. In one large tract stated to have been naturally renewed 20 years ago, the young trees are certainly not more than 6 feet high on an average, and in another, replanted 12 years ago, it does not exceed 3 feet. This is however quite exceptional.

Forest laws.

With regard to forest law, Bavaria is divided into two portions, that on the left bank of the Rhine commonly called the Pfalz, and that on the right bank. Up to the year 1846 the forests of the former were managed under the authority of regulations of 1814, and a Forest Act of 1831, which in that year (1846) were revised and embodied in an Act, under the provisions of which the forests have since been administered. Up to the year 1852, there was no general forest law for the provinces on the right bank of the Rhine; numerous regulations and mandates, some of which dated so far back as the seventeenth century, were the only guide.

The Act of 1852 is very comprehensive, and provides for the treatment of all descriptions of forest, state, communal, ecclesiastical, and even private, in cases where the management of the latter has any bearing on the general welfare of the people or interests of the State; in fact, the extent to which purely private forests are under Government control in Bavaria, where they constitute nearly half of the total area under wood, is very marked. A study of this Act (*Das Forstgesetz Baiern*) is particularly recommended by Dr. Brandis in his memorandum; and I can well imagine, from what I have read of it, that it might serve as a model for guidance in any future legislation on the subject in India; but I have not had time to study it sufficiently to give even an epitome of it here. The salient points, and those in which it differs from the law in force in the Pfalz, are very clearly stated in "*die Forst Verwaltung Baierns*," section 38, pp. 112–141, where the reasons for the continuance of two separate laws in the same kingdom are also stated, and the results of the Acts since they have been in force are shown in tabular statements. (See also an appendix to "*die Forst Verwaltung*," known as "*Forststatistische Mittheilungen aus Bayern*," published in Munich in 1869.)

Breaches of forest laws seem most common in the Pfalz, where the average number in State forests alone is 116 cases

yearly per 1,000 tagwerk, whilst in Oberbayern the average on the same extent is only 9! and throughout the whole kingdom 37. Regarded with reference to population, we find the Pfalz again heading the list, one person out of every seven having apparently been guilty of a breach of forest law, whilst in the province of Nieder Bayern the average is only one in every 279. The same per-centage holds good with regard to the communal and other forests. There is a marked falling off in the number of cases for the period from 1861 to 1867, as compared with the former period of seven years; but it is remarkable that the several provinces retain their relative positions in both.

We must conclude from the above that the law is more stringent and more strictly administered in the Pfalz, where there are also probably greater temptations to break it in the shape of high prices, a convenient market, or great want of grazing ground; for the cases are classed as mischief to, *a*, wood; *b*, pasture; *c*, grass; *d*, straw; *e*, miscellaneous; besides theft of wood and trespass; and the local circumstances of the other provinces must evidently conduce to the frequency of breaches of the law or the reverse.

The average number of cases yearly during the period from 1861–1867 seems very large, amounting to 103,310 for the purely Government forests, and 99,289 in other forests, making a yearly total of 202,599 cases, a decrease, however, of upwards of 50,000 compared with the annual average of the seven years immediately preceding, and of 80,000 compared with that from 1849 to 1853. The usual punishment would appear to be by fine, with imprisonment in default.

I must now close this very imperfect report of what I saw and learned in Bavaria, and endorse Dr. Brandis' recommendation of a study of "Die Forst Verwaltung Bayerns" to all who are anxious to make themselves thoroughly acquainted with an excellent and comprehensive system of forest management.

AUSTRIA.

Not the least interesting or instructive part of my tour was the time spent in Austria, which was, strictly speaking, beyond the scope of my official tour, but where I received every attention, information, and assistance from the Baron Clummecky, chief of the Ministry of Agriculture, to whom I was introduced by our ambassador at Vienna, and Ober Forst Meister Tchuppitch, the head of the forest branch of the Agricultural Department.

Scientific forestry is not so far advanced in Austria as in Germany.

Transfer of the Forest Department to the Ministry of Agriculture, and re-organisation.

The department has recently been transferred from the Ministry of Finance to that of Agriculture; and Herr Tchuppitch was busily employed in preparing a scheme of re-organisation, which has, doubtless, since been introduced; and provides for the entertainment of a suitable staff of forest officers, with adequate salaries, to be divided into control and executive, with the requisite number of subordinates; the definition, and, where practical, the extinction of servitudes; and the more systematic conservancy and working to the best advantage of all the Government forests and communal woodlands under Government control.

By the introduction of these and similar measures there is no doubt that Austria will ere long possess a forest department on a par with those existing in other continental states, both as regards knowledge and organisation.

Area.

The State forests, notwithstanding the extensive sales which have taken place from time to time to meet State necessities, extend over an area of 1,784,037 Austrian *yochs*, equal to 2,230,046 English acres, of which 522,678 *yochs* (653,347 English acres) are classed as unproductive. This latter extent will probably be greatly reduced and brought under crop under the new *regime*, with a better knowledge of the resources and methods of culture of modern forest science.

Yield.

The *état* or estimated annual yield of this large area is given as 65,838,200 cubic feet of timber, firewood, &c.

Receipts and disbursements.

The budget for 1872 shows a gross income of 4,148,653 guldens, with an expenditure of 3,049,476 guldens, leaving upwards of 1,000,000 guldens (say 90,000*l.*) as clear profit to the State. The income is exhibited under three heads; 1. Sales of timber, firewood, &c.; 2. Renting of lands not covered with forest (this is a very small item); 3. Forest products and miscellaneous receipts. The Expenditure divides itself, as with us, into "Ordinary" and "Extraordinary," the former including, 1, Charges for felling and

transport of timber and charcoal, planting, repair of forest buildings; 2. Charges incurred on account of lands not covered with trees (a small item); 3. Charges for collection of forest produce, &c.; 4. Establishments; and, 5, Taxes and burdens for religious and educational purposes. Under extraordinary are classed purchase of lands, purchase and erection of new buildings, and extra establishments. The value of existing forest rights or servitudes is estimated at 530,711 guldens (say, 50,000*l.*) per annum.

The existing establishments are not uniform throughout the Empire, each of the 12 provinces or divisions of the empire having a separate organisation and establishments, differing widely in nomenclature, strength, duties, and emoluments. All that can therefore be stated on this subject is, that there are in all 1,170 *employés* on fixed salaries (amounting to 392,644 guldens per annum), and of this number 22 are Forstmeisters, or officials holding a corresponding position, in charge of divisions or circles. The extent of these circles and nature of the duties to be performed varies widely. Some are, I was told, almost sinecures, whilst in others there is work for six controlling officers instead of one, and it is much the same with the executive.

Forest academy at Mariabrunn.

The Austrian Forest Academy is situated at Mariabrunn, near Vienna. The course lasts three years, and there were, when I visited the institution, 35 students.

The museums or collections are particularly fine and interesting to the forester, particularly the sections known as "*Forst Betrieb*" and *Ingenieurs-Museum.* In the former are collected specimens of all instruments and appliances made use of in felling, squaring, sawing, carting, and preparing timber; models of saw mills, and machinery of all descriptions, from the rude and simple apparatus of former centuries, still in use in some of the remote mountain forests, to the more effective, but at the same time more complicated methods of modern times. Here are also plans of river beds improved and embanked for floating, sluices of all sorts, dams and weirs for directing rafts in their course and catching the firewood, which is floated in billets, accurate models of the rafts themselves, showing exactly how they are constructed, and specimens of timber of all sorts prepared in various ways, and containing many samples from foreign lands, not a few being from Madras and Ceylon, brought by the Austrian expedition which sailed round the world in the frigate "Novarra," three years ago; these last are only now being arranged, and there is some difficulty in mastering the nomenclature, which having only been noted in the vernacular is very confusing.

The damage done by animals and insects to timber trees is also exhibited here in a comprehensive manner; though in this the collection falls short of that at Neustadt-Eberswalde, which, however, it surpasses in other respects.

The value of such collections to the forest officer or student cannot well be over-rated, and I hope we may not be long in commencing their formation in Madras. In fact, no divisional or range office should be without one; this has, I am aware, been repeatedly enjoined, and a commencement was made in the Salem district; but it is impossible to expect much progress in this respect until adequate accommodation is provided at the head-quarters of each range and division.

There is also a forest or botanical garden attached to the academy for the instruction of the students.

The staff of the academy consists of the director, Herr Newald, to whom my best thanks are due for the attention and civility I received; seven professors, including one honorary teacher, and six assistant professors, with subordinates in the account office, laboratory, &c. There is also a forest school at Brühl, for training young men as practical foresters, which is under Herr Newald's supervision and the immediate charge of the local forest officer. The course extends over ten months, and there were eight young men going through it when I was there.

Forest school at Brühl.

The training in both establishments is said to lean too much towards *theory* in comparison with *practice*, but this will doubtless also be improved under the new managements. I was astonished to find that the greater number of those trained in both institutions are intended for private and not Government service; their actual expenses for board and lodging being in many cases paid by noblemen and large proprietors, from whose estates they come, and to which they return as forest officers and workmen. The State defrays the expenses for the up-keep of the institutions, including salaries for the professors, &c., and there are no extra fees. This cannot fail to have a marked effect in tending towards the intelligent management of the private forests of the empire, which are very extensive. The absence of numerous candidates for the Government forest service, and preference evinced for private employment, is very noteworthy, especially when compared with the state of things in Prussia, Saxony, &c., where the number of aspirants for the Government service is out of all proportion to the annual number of vacancies. The irregularity of promotion, want of system, and lowness of the salaries in the Austrian service furnishes a ready explanation for the difference.

Districts visited.

I visited the forest reviers, Purkersdorf and Gablitz, with the Ober forst meister. The reviers form a portion of the large forest known as the *Wiener Wald*, which extends over an area of 60,000 English acres, and is of great value, being in the immediate vicinity of Vienna, which draws almost its whole supply of common building timber and firewood from it. It affords also a means of recreation, health, and enjoyment to the population of the capital, such as is possessed by the inhabitants of no other city in Europe, and the pleasure-loving Viennese are not slow in making use of its advantages, and pour out on Sundays and holidays from the hot and dusty town in large numbers.

The reviers visited consisted mainly of beech, which has been allowed to renew itself from time immemorial without any attempt at systematic management or rotation of crops. True the whole forest has been measured, valued, and mapped, but it is not divided into blocks, or worked regularly in periods, and I believe this is the case throughout its whole extent. The result is shown in a comparatively low and even decreasing yield per acre, and patchy or irregular appearance of the woods; and nothing but the naturally extreme richness and fertility of the soil, the fertilising qualities of the beech leaves, and comparatively limited demand and consequent felling until of late years, could have obviated a much worse state of things presenting themselves ere now.

As I have often found the case in India, a cursory glance at the forests from the outskirts or borders would lead one to suppose that it is fairly stocked with timber; but a more careful inspection proves that such is not the case, and that only in the valleys and more remote portions where the soil is particularly good, and the axe has not been so frequent in its inroads, is there a fair and regular crop. The gradual division and assortment of the area into blocks and periods, planting up of bare and insufficiently covered tracts, where natural reproduction is impossible from the absence of standard trees, and the introduction of a considerable percentage of *conifers* (e.g., *Pinus austriaca*, *Abies pectinata*, and *nobilis*), both on acount of exhaustion of the soil by successive crops of hardwood trees, and the quicker growth and greater money yield of the *coniferæ*, appear to be the principal points to be attended to, and which Herr Tchuppitch has in view.

I visited also the forest revier of Brühl, in the Mödling division, which has an area of 4,000 English acres, chiefly *Pinus austriaca* on one side of the valley, and beech in the other; the latter a good deal intermixed with ash and hardwood trees of inferior value, such as maple, plane, birch, &c. The black Austrian pine has a period of rotation (*umtriebs-*

zeit) of 100 to 120 years, growing slowly and with a tendency to branch. It has hitherto been the custom to tap the trees, about 15 to 20 years before they were to be felled, for the resin or turpentine which exudes, and from which the turpentine oil of commerce is procured. Such trees were leased out to contractors at an average of about 3*d.* per tree per annum, and one contractor has now 24,000 trees in the Mödling division on this system. The trees are tapped in spring, and cease giving sap in autumn. The method pursued in tapping and collecting the sap or resin is simple, but it would be of no practical benefit to describe it here; besides, it could probably be improved on, and experiments are even now about to be made on the French system, by which the sap is not so long exposed to the sun or atmosphere before being collected. There is at present a controversy going on as to the whole subject, *i.e.*, whether it pays or not to tap the trees, the old school maintaining that it does, the rates per tree being considerable, and the tree continuing to increase in growth. This last point is disputed by the opponents of the system, which will probably soon be put a stop to, as has been already done in the Black Forest in all but exceptional cases, the more so as the resin or turpentine cannot, strange to say, be brought into the market so cheaply as that imported from America. During the civil war in that country large stocks were tied up in the several harbours of the Southern States, and the price on the continent rose very greatly, only to fall suddenly on the close of the war, and ruin numbers of sanguine operators who had entered into large contracts, and taken large tracts of Austrian pine forests on lease.

Tapping of pines for turpentine.

The natural reproduction in this revier is very irregular. It is interesting to note that the sides of the hills with a western exposure are covered with pine, whilst on the opposite side hardwood, chiefly beech, predominates. Prince Lichtenstein is taking great pains and expending large sums of money in endeavouring to cover some low hills in the neighbourhood, which form part of his property, with pine trees. The soil, which consists chiefly of dolomite, is very unfavourable, and the prevailing high winds offer another obstacle, which renders the progress slow, and any adequate return from a financial point of view out of the question.

Most of the timber from the Mödling division is sold as firewood, divided into five classes according to description, each class being again divided into five sorts according to size, &c., the price varying from as much as 22 guldens for first class, first sort, to 2½ guldens last class, last sort, per klafter.

FORESTS OF THE PRINCE OF FURSTENBERG IN THE GRAND DUCHY OF BADEN (BLACK FOREST).

Area.

The area of the Prince of Furstenberg's forests, under the charge of Oberforstrath Roth, is 80,617 Baden morgens, equal to about 72,555 English acres; and the annual yield is estimated at 56,000 massenklafter, stated to be equal to about 5,443,200 cubic feet, being an average of 75 cubic feet per acre of forest; but I am inclined to think there must be some difference betwixt the Baden foot and ours, *vide* Statement at page 67.

Yield.

Receipts and disbursements.

This being a private estate, the annual receipts and disbursements and surplus cannot of course be given, but the Oberforstrath informed me that the forests were on the whole economically worked, and the liberal sums expended on road-making, improvement of the rivers for floating, housing, forest officers, &c. were well repaid by the facility of transport, and contentment and zeal of the employés. The forests are, in fact, worked for the best profit compatible with their retention as capital, and it is evident that a private individual is not burdened by considerations of policy and the good of the people at large to the same extent as a State or even a community.

Establishments.

The forests of the estate are divided into 16 reviers, each under charge of a *Forstverwalter*, corresponding to the Oberförster of Prussia or Bavaria; and the whole upper establishments therefore consist of one Oberforstrath, and one Forstrath (councillor) at Donaueschingen, and 16 Forst verwalters in charge of the reviers.

Of the 16 reviers, six are situated in the valley of the Danube, and consist chiefly of beech forests; three extend south of Donaueschingen towards the Boden See (Lake of Constance), and contain mixed forests of hardwood and fir, whilst the remaining seven are in the Schwarz Wald (Black Forest), two in the northern and five in the southern portion, and may be said to consist entirely of coniferæ, *i.e.*, spruce (*Abies excelsa*), Scotch fir (*Pinus sylvestris*), silver fir (*Abies pectinata*), black Austrian (*Pinus austriaca*), and a little larch (*Larix europæa*).

I had an interview with Oberforstrath Roth at Donaueschingen, and received from him the general information I have just stated, and an introductory letter to Forst Verwalter Ganter at Rippoldsau, the revier mentioned in Dr Brandis' memorandum as being the most generally instructive.

The Rippoldsau revier is situated in the north-east corner of the Black Forest, "on the headwaters of one of the feeders "of the Kinzig river." Rippoldsau itself, where the Forst verwalter lives, and where there is a large hotel and mineral springs, is about 2,000 feet above the level of the sea. The area is 6,459 morgen (Baden), equal to 5,812 English acres, and presents a diversified appearance of hill and valley, the former running up to 3,250 feet above the sea, with their steep sides clothed from base to summit with spruce and silver fir, which are the predominating trees. The Rippoldsau Revier.

I remained 10 days at Rippoldsau, and inspected the several divisions of the forest, studying, at the same time, the general working plan and chart which the Forst verwalter placed at my disposal.

The main points deserving attention are, first, the peculiar character of the working or management as compared with the forests I had hitherto seen; second, the system of forest roads and transport of wood by land; third, the floating down the narrow mountain streams, and afterwards on the Kinzig river itself. The peculiarity of the working consists in the lengthened period over which the felling or clearing of a block extends. This is often as much as 40 years from first to last; in fact it is difficult in many instances to say when the block passes from one period (the oldest) to another (the youngest), so gradually is the old crop thinned out and removed. This method, which has long been more or less in force in the Black Forest, is now finding favour in other parts of Germany, as already noted in the Hanoverian and Saxon sections of this Report, as it is found preferable to the quick clearing, or "*kahl abtrieb*," formerly so much in vogue. It need scarcely be pointed out, however, that it requires much attention and intelligent treatment to ensure the success of such a system; for the seed will not germinate nor the seedlings flourish without a sufficiency of light, and the forest officer must be ever on the watch to see that they get it; and again, much greater care is necessary in felling and removing the old crop when the trees are already surrounded with saplings than when the seedlings of the new crop are not above one or two feet in height, and in this the axemen and foresters of the Black Forest are adepts; hence the damage done is really wonderfully slight, and a mere bagatelle compared with what it would be in less skilful hands. Peculiar features and system.

The turf and thick herbage is, as a rule, removed in patches in order to receive the seed and give it a fair chance of germinating and making its way, and the nature of the

herbage or undergrowth has not a little to say to the rate of clearing or quantity of light to be admitted in order to carry on the natural reproduction to the best advantage.

It may be said that a clearing which extends over 30 or 40 years differs little from the "Plänter-betrieb" already alluded to; and there are, doubtless, some analogous points, but the similarity vanishes when the matter is carefully looked into, and there are many differences in the details of the system, which, whilst they require to be seen to be noted and thoroughly understood, effectually separate the one treatment from the other.

Analogous system apparently suitable for Southern India.

A great deal must always depend upon the circumstances of climate, situation, and establishments available, but the gradual clearing, with an eye to natural reproduction in force in these forests, appears to me particularly applicable to our forests in southern India, provided we can organise and retain in a state of efficiency, 1st, reliable *employés* to watch each tract and ensure its treatment in a rational manner; and, 2nd, the workmen to fell and remove the old trees in anything like so careful a manner as those in the Black Forest. My own experience of our axemen and woodmen in India is certainly not favourable to our arriving at anything approaching to such a state of perfection; but I have not had to do with those in the Anamullays, who, I presume, are the best; and it has not hitherto been considered necessary to pay much attention to the matter, although each year its importance must become more manifest.

I was particularly struck with some "acquisitions" purchased by the Prince from peasants for 60,000 guldens (5,000*l.*), which are gradually being converted from "*Hack Wald*" into fine high timber forest of spruce and silver fir.

Hack Wald.

Hack Wald is a name given to a system formerly much in vogue in the Black Forest, and still pursued in remote, semi-civilized, and scantly-populated localities, and has some points of resemblance with our "kumari" or "ponakâd," except that the main desideratum appears to be, as a rule, wood, especially hazels and oziers for hoops of barrels, baskets, &c., and not a crop of grain. It consists in clearing the ground of the "jungle" every 16 to 20 years, cropping it for two years or more with grain or pulse, and allowing the coppice to grow up again. This treatment formed the subject of a very interesting discussion at the local forest gathering or "*Verein*" last year, in which, although the treatment, viewed from a forest light, was universally deprecated and condemned, many reasons were

brought forward and explained to the meeting for its retention, in remote localities at least, for some years longer, as affording employment and a livelihood to a certain class.

The portion of the high marshy plateau of the Kniebis, included in the Rippoldsau revier, has now for the most part been drained and planted with spruce, which, considering the poorness of soil, exposure to high winds, and severe winters, is doing fairly well.

The *état* or yield of timber from the Revier for the decennial period from 1865 to 1875 has been fixed at 380,000 cubic feet, or an average of 65 cubic feet per acre annually. It is divided for purposes of sale into classes known as Holländer-Holz, Bau-Holz, Säge-Holz, and Gemein-Holz. The Holländer-Holz consists of the fine stems of from 60 to 85 feet in length, and 12 inches on the square, whilst the Gemein-Holz includes that under 18 feet in length, and 9 or 10 inches in diameter. The average prices vary from 8*d.* to 6*d.* per cubic foot, having fallen considerably of late owing to the occurrence of severe storms, which have blown down and thrown on the market large quantities of timber from these forests and others in the neighbourhood.

The right of pasture in the forests is, as a rule, leased out by the executive forest officer.

Forest roads.

The system of roads in the Rippoldsau forests appeared to me to approach very nearly to perfection, and the Forstverwalter is justly proud of what he has effected in this respect. I was fortunate enough not only to see those already in use, but several in course of construction. They may be divided into two classes, the first comprising roads 12 feet wide, and the second paths 6 to 8 feet wide. The former cost on an average nine guldens per rood of 10 feet, say 5*s.* per running yard, and the latter about two guldens per rood, say 1*s.* 1½*d.* per running yard; and it must be remembered that both are carefully laid out, and most substantially constructed with solid masonry, embankments, and culverts, wooden bridges, &c. There were 11,601 roods of such roads in the revier up to 1865, and 13,488 have to be constructed during the present period, *i.e.*, prior to 1875, making a total length of nearly five miles. Many of the paths are now being transformed into roads of 12 feet in breadth. It must be borne in mind that the Government high road (one of the finest I have ever seen) may be said to intersect the forest, otherwise a much greater length of purely forest roads would be necessary.

Timber slips.

In addition to the roads are the "*Riesen*" or slips, down which the timber is shot. The manner in which this is

effected requires almost to be seen to be understood, and unfortunately slipping was not going on when I was there. The method was, however, repeatedly explained to me, and I think I could apply it, though I fear it would only be practicable with pine trees stripped of their bark, or perhaps with the Australian *Eucalypti*. The paths down which the timber is slipped are about 6 feet wide, running along the sides of the hills, and not necessarily very steep. Small pieces of wood or rollers are generally placed along them crosswise at intervals of about 2 feet. When timber is to be slipped smooth pieces, stripped of their bark, are laid along on either side, so as to form a trough or slide, down which the other stems are then shot. It is astonishing what curves they will thus get round, and the facility and the rapidity with which the work can be effected may be imagined from the fact that 300 stems can, with ease, be slipped in one working day. Where the curve is too sharp for the tree to get round, a right or acute angle is preferred, and the stem which has been shot down the first portion, say with the narrow part first, is, without much trouble, by the aid of a wonderful and simple instrument, called a "krempe," sent on its way inverted, *i.e.*, with its broad end or base in front. When the stems which form the trough get dry they are oiled, and sometimes bark is strewn on the "road" to make it more slippery. In winter the snow is taken advantage of, and then only sides or walls to the trough are required to prevent the stem shooting off the road. There is, of course, a great deal of knack in the construction of the riesen and management of the slipping, and a Black Forest woodman appears to be able to put his logs where he likes; in one instance, which I saw, they were made to shoot over a road (the King's or Grand Duke's highway), a temporary bridge being formed, under which carts and foot travellers could pass, and jump a river or stream some 20 feet wide, down which they were afterwards floated in rafts 2,000 feet long!

Use of the *krempe*.

The *krempe*, alluded to above, is an instrument with a heavy iron head, something between an adze and a pick, and a longish curved wooden handle, which in the hands of a skilful woodman is most useful in moving stems, which it would be difficult otherwise to get hold of, far less to turn over or move as required. The curved handle gives great leverage, and the Black Forester is very expert in using the instrument, which is rarely out of his hands in the woods or on a raft, the sharp end being driven into the log by a smart blow in order to lay hold of and move it from one place to

another, or the broad thick end used as a hammer if required. I saw stems moved out of a clearing on to the road with comparative ease by half-a-dozen men provided only with krempes and a strong rope, for which we should have required elephants in Madras. The clearing was on the side of a steep rocky hill, and the trees of an average length of 50 feet were lying "higgledy-piggledy," with a young crop of from 8 to 15 years old coming up all round them, so that it seemed all but impossible to remove them at all without sawing them into pieces, and still more so without greatly damaging the young growth. As I have said, however, it was effected without any great damage or trouble.

Use of the sleigh for removing firewood billets.

There is also an excellent description of sleigh in use for bringing firewood billets down the steep hills. These are very simple of construction, and made up by the woodmen themselves, and it is marvellous to see mere boys walking up the steepest hills with the sleigh on their backs, and returning, dragging, or rather guiding, it after them with a load which no six men could carry; in fact, which could not be brought down the steep inclines in any other way. The sleigh is "dragged" as required by means of chains and bundles of firewood tied behind, in order to prevent its going too fast, and running away with its load and the man or boy who is guiding it in front.

Economical working of the forests.

It is by these and similar means that the Forst verwalter is enabled to fell, slip, and float his trees to depôt at a cost of 4 kreuzers—say $1\frac{1}{2}d.$ per cubic foot all round—and thus by selling at $6d.$ to $8d.$ per cubic foot realise a handsome profit, after paying all charges for supervision, planting, sowing, &c., &c.; and it is here, I think, that so much remains to be done by us in India, where the rates we now pay for felling and removing our timber, even in the rough and wasteful manner in which it is now done, are very high. Improvement in our means of communication, and introduction of and teaching the natives how to use better appliances for felling, and getting the logs out of the forests, and working them up when we have got them out, appear of paramount importance in our forest management.

Floating.

The cost of 4 kreuzers per cubic foot is divided into—felling 1 kreuzer, slipping $1\frac{1}{4}$, and floating $1\frac{3}{4}$ kreuzers. It is impossible to convey by words an idea of how the latter is carried on. It must be seen to be understood and believed, and I am not sanguine of its ever being introduced into our Indian forests, except in a very modified degree, and on the larger rivers; in fact, the high specific gravity of most of our woods, and torrent-like nature of our mountain streams,

preclude the idea in all but exceptional cases. Still it may not be without interest to state briefly how it is carried on here, even in quite small streams of from 15 to 20 feet in width. The streams invariably require to be prepared more or less for floating, that is cleared of any very large rocks or boulders, and "sleepered," if I may use the expression, with pieces of wood firmly fixed in the bed of the stream every few yards; in fact, in the same way as in the *Riesen*, except that the sleepers or rollers are much larger and placed further apart. These not only have the effect of preventing the formation of any very deep holes in the bed of the stream, but serve for the raft to slide along when it touches the bottom. Reservoirs for storing water are constructed in the same manner as I have described in the Report on Scotch Forests (page 108), as the floating cannot be carried on when the stream is in flood; in fact, the less water in it the better, so long as sufficient is stored up above to carry on the rafts. My first impression when I saw the *Floss* or float, consisting of stems from 20 to 60 feet in length tied together at the ends by branches or coir from the hazel, walnut, and silver fir, of which the hazel is preferred, and lying zig-zag in the bed of a mountain stream, up and down which they extended 1,600 feet, was that it was simply impossible that they could ever be floated, still less steered down the stream with all its windings and over the locks and rocks which occurred pretty frequently. This raft was not quite ready, and I had an opportunity of noting how it was constructed. It contained 880 stems, eight or ten of which abreast formed as it were a "link" in the long raft of 1,600 feet. There were about 30 links or rafts in the floss. They are not fastened laterally, only at both ends to the next link. The breadth is greatest at about two-thirds from the prow, which is quite narrow, and consists of only two or three stems abreast (in front of all is a piece formed of old wood and raised out of the water like the bow of a whale boat, so as to lead the raft), and the largest and heaviest stems are placed in the broadest part and toward the stem or hinder part, which does not taper at all. The fastenings are made very secure, but not too tight, as they must allow for play.

Preparation of the bed of the stream.

Construction of the rafts.

There are two or three *Bremsen*, or breaks, by which the speed is regulated and the float brought to a standstill if required, and the charge of the largest of those which is the farthest back is the most responsible post, and devolves on the float-master himself, or, in his absence, the most experienced hand. When all is ready the water from above is let loose, and the raft or rafts which have hitherto been lying in

the bed of the stream, which has probably not more than a foot of water in it, begins to float a little, but is not let go until about two-thirds of the water have passed, as it is a curious fact that when let go, if there is a steep fall in the river, it travels faster than the water, and has often to be stopped on its course to let the latter get ahead of it again. The raft is manned by eight or 10 men and boys, one or two of whom stand quite in the bow to guide the prow, the others make themselves generally useful, whilst at least one or two of the best hands stand by the float-master at the break, on which the safety and good guidance of the whole depends.

When let go it is exceedingly curious to see the forward part dart off at the rate of five or six miles an hour, and the several pieces or links which have been lying zig-zag and more or less high and dry gradually uncoil themselves and follow in its wake till the whole dashes along at a great speed and apparently uncontrolled. Accidents are, I believe, rare, but this can only result from the floaters being trained to the work from their youth up (I saw little lads of six and eight going down in miniature floats); as for one not accustomed to it, it is well nigh impossible to remain on the float at all, as it literally springs sometimes out of the water on touching a rock or obstruction, dashes round a rapid turn in the stream, or jumps over a weir or anicut, with a fall of several feet.

In this manner 40 or 50 miles can be got over in a day, if the stoppages, to allow of the water getting ahead, are not too frequent, or the stream does not become swollen by mountain rains. On reaching the main stream, in this instance, the Kinzig (the small stream is called the *Wolf*), the rafts are taken to pieces, and formed anew into those large rafts with which everyone is familiar who has travelled on the Rhine, the Main, the Elbe, or the Danube.

The raft which I saw was shorter, and contained a greater proportion of small stems than usual, being the last of the season. They are, as a rule, at least 2,000 feet long, contain 1,000 stems, and are manned by 12 men and boys. The broad portion is always made as broad as the river or stream, failing which there is a tendency to turn round, or get side on to the stream.

Many of the Black Forest floaters have been induced of late years to migrate to Hungary, in order to introduce the floating down the mountain streams into the large pine forests there. They receive very liberal wages as an inducement to go, but, as a rule, return after a year or two, and

complain bitterly of the climate, and laziness and want of aptitude of the "natives."

I trust the foregoing description of floating may serve to convey some idea of it to those who have not seen it, or have seen it only on large and comparatively slow flowing rivers; but, as I have said, it requires really to be seen to be understood and appreciated.

I do not know of any other points connected with forest management in the Rippoldsau revier which might with advantage be detailed here; so much is noted and learned by personal inspection and study of any occupation which cannot be put down in writing, or communicated to others except in the course of practical working; and particularly is this the case in the case of these forests, where there is little theory or scientific talk, but a thorough practical knowledge and experience of what to do and how to do it, rendering a visit particularly instructive to a forest officer.

GENERAL REMARKS.

Forestry in Germany is truly a science, and differs very widely from anything I have seen called by the same name either in India or England. I do not advance the theory that the German system is perfect or applicable to all States or circumstances, and still less that we in England do not grow as fine trees, or do not know how to plant and rear young trees for timber. If any have doubts on these points I would point to the Swinley woods under the charge of Mr. Menzies, and portions of the New Forest under Mr. Cumberbatch, which may challenge comparison with any oak plantations of the same age on the continent; but I do think, and am sure that any who have studied the subject and made themselves thoroughly acquainted with it by personal observation, will agree with me, that compared with most of the German States we are behindhand as regards the systematic and scientific management of forests on a large scale, and as a part of political economy to which it is incumbent on a government to attend. In fact, looked at in this light, I venture to affirm that we are as far behind Germany in the knowledge and application of scientific forestry as we are in advance with regard to agricultural pursuits.

Advanced state of forestry in Germany.

I grant that for England State forests are not a necessity (although I am not sure that we may not some day regret their absence or limited extent), for she can command the market for timber, burns comparatively little firewood, has a very small area, almost every acre of which is of great value either for building or agricultural purposes; and from the many large estates which exist throughout the country, and the naturally luxuriant growth consequent on a moist climate is, on the whole, well wooded, although for the most part the woods are grown for luxury (*e.g.*, enhancing the beauty of the landscape, affording cover for game), and not merely regarded as timber-producing areas.

Large State forests not a necessity in England.

Again, private enterprise and intelligence effects a great deal more with us than on the continent, where Governments are still often looked to to originate and take the lead; and we often drift, so to speak, into the right channel without exactly knowing how or why.

I would therefore merely venture to remark as to Government or State forest management in England that where it does exist no efforts should be spared to make it as perfect and lucrative as possible, and I am convinced that this can

only be done by the introduction of a thorough system of rotation and periods based upon carefully prepared measurements, valuations, and working plans, forming a definite plan of operations with certain objects in view, and not mere desultory planting liable to interruption at any time by a change in the Government or commissioner of woods, or on the *ex parte* statements of the commoners, whose rights should be definitely settled in one way or another.

Necessity of State forests on a large scale in India.

In India, however, the position is quite different. Not only is there a large and ever increasing local demand to meet the wants of a population of upwards of 200 millions in the shape of building material and firewood, a demand which can never be met from abroad, but we have to consider such questions as climate, rainfall affecting the irrigation and cultivation of thousands of acres, and supply of wood fuel to the railways, any curtailment or enhancement of price in which means greatly increased working expenses and consequent loss to Government.

In India the people still look to Government for everything, and will do so for many a year to come, and there is little or none of that peculiar form of private enterprise which will plant and conserve forests on scientific principles, introduce better methods of felling and converting timber, and look into and provide for the future and its wants.

All this devolves on the Government, and particularly so, I consider, with regard to forests, which must be regarded and managed as a whole, and with regard to the general good, and cannot be left to the individual caprice of private individuals or even communities; for trees do not grow in a few months or a year, like rice or corn; nor can one portion of a forest be managed like a field without reference to the surrounding tract.

Most of the larger forest tracts are, besides, in the hands of the State as assessed or unassessed waste, and will if properly administered form a great and ever increasing source of strength to the rulers of the country.

The German system modified according to circumstances suitable for India.

The Government having granted by the gradual formation of a distinct forest service, the necessity of establishing a system of forest conservancy, and administering and working the forests by degrees on more well-defined principles and to the best advantage, the question naturally presents itself, where are we to look for a model or precedent on which to work? and the reply appears ready; to Germany, where forestry and particularly the management of forests by the State has been carried on for hundreds of years. Not the mere planting of a few hundred acres here, or reserving a

few thousand acres there, but a general system of forest management, commencing by a careful survey, stock taking, definition and commutation of all rights and servitudes, careful experiments in the rate of growth, the best soil for each description of tree; in fact, in every branch of the subject, and resulting in what we find to-day, in Hanover, for instance, hundreds of thousands of acres mapped, divided into periods and blocks, and worked to the best advantage both with regard to present and future, and the annual yield of which now and for many years to come is known and fixed to within a few hundred cubic feet.

The great difference in climate and local conditions between India and Germany would doubtless necessitate important modifications and deviations from the plan pursued in the latter country at each stage in the development of our forest system, but I can see no reason why the broad principles of organisation and forest management should not be applied with success to our Indian forests not hastily, or without careful preliminary experiment, but very gradually, feeling our way both as regards the best mode of treatment for the several classes of forest, and the wishes and interests of the people and State.

Definition of State and communal forests; their demarcation, survey, and settlement absolutely necessary.

I would commence by the definition of what constitute State and communal forests, which should then be demarcated and surveyed, mapped, and valued, divided into blocks and complexes, and working plans prepared for their management.

Since I have studied the matter in Germany this appears to me the very foundation and essence of good forest management, as by these steps we arrive at a definite plan and fixed idea of the objects in view, and how best to arrive at them, so that the management ceases to be desultory and personal, varying widely according to the views of the forest officer in charge, the district collector, or even of the subordinates of the revenue and forest departments. One very important matter to be settled, one which has, in fact, I may say, formed the stumbling block hitherto in Madras in all our attempts at dividing the forests betwixt the State, the communities, and individuals, is that of rights and servitudes; and I think that what I have seen and learnt on this subject alone during my tour in Germany repays the trouble and expense, even had I learnt nothing else. I advocate the speedy definition, registration, and, wherever possible, buying up or commutation of all such rights; and I think an Act and the appointment of a joint commission are necessary to enable us to do it; but I think I take a much broader and

Servitudes to be liberally construed, but defined and, if possible, commuted.

more liberal view of what constitute rights and privileges than I held when I left India, and since I have seen and read that the same sort of thing has been universal in Europe, and that it is only now in some States that a settlement is being arrived at, and that the people are becoming alive to the fact that it is to their own interest to commute privileges often vague and ill defined for a money payment, a fixed quantity of wood per annum to be handed over to them by the forest department, or the right of pasture within a limited area. I think we cannot well take too broad a view in settling and defining the servitudes, even when the right is doubtful, but I am convinced that they should be defined, and as much as possible cancelled by liberal money compensation or annual allotment of timber or firewood. With regard to pasture, I would hope to be able to throw open all the forests, as they grew out of danger of damage from legitimate grazing, to the public at large, with certain well-considered restrictions and not easily evaded punishments in the event of mischief being done by the owners or herdsmen, and, if thought advisable, on payment of some small annual fee; but I deprecate the extension of any special rights to particular villages and persons, and consider it expedient to commute or endeavour to commute them where they already exist. No more analogous position to that which we are now in, and no better guide for settling matters justly and to the best advantage of all parties concerned, can be found than in the history of the progress of State forest administration and legislation in many of the German States.

Absence of all enclosing in German forests and plantations.

Nothing struck me more wherever I went than the entire absence of fencing and enclosures, considered so imperatively necessary in our Indian and English forest management. Bunches of dry grass tied to the branches of the outer trees suffice to denote forbidden ground, and to deter people from entering or driving in their cattle. And I am informed that trespass in such places is very rare and generally inadvertent. There is, of course, a staff of watchers, and punishment follows detection, but considering the extensive area and consequent comparatively small chance of detection, it must be something else which exercises a deterrent effect, and I am inclined to look for it in the knowledge that the whole question has been thoroughly inquired into and settled, and that Government or its forest officers will not exclude man or beast unless absolutely necessary for the good of the forests, of which all classes have learnt to know and appreciate the value.

I do not think we have much to learn from the Germans with regard to the planting and rearing of young trees, but it is with regard to the best methods of managing groups of plantations or masses of forest that I consider we may with advantage take a leaf out of their book.

Points on which the German system may serve as a model for India.

For instance, I would certainly introduce in a tentative manner, and at first on a very small scale, their system of rotation, clearing, and periods, and endeavour to bring forward a second crop before the first is off the ground, encourage the growth of the better descriptions, and keep down the less valuable, and to improve our "Plänter-betrieb," or selection of single trees to be felled, so as gradually to arrive at groups of trees of the same age, description, and class, and eventually at blocks worked in rotation, and containing always a sufficient stock or crop coming on to meet the requirements of future years.

To arrive at all this the most careful observations and experiments will have to be made as to the rate of growth and yield per acre of each description of forest, the conditions under which trees grow best and form the most timber, some requiring close and some open planting, some nurses and some not, some, like the oak, requiring a great deal of light, whilst others, like the beech, do well for many years in shade. All these points, and many more, demand attention, and till they are settled we shall be merely groping in the dark. In fact, I think it may be taken for granted that all we do in the way of forestry in the Madras Presidency during the present century at least, will, after all, be but experimentalising, which fact, however, need in no way delay the demarcation, survey, and settlement of the forests. These are, in fact, the first steps towards the initiation of systematic experiments, from the results of which valuable statistical data may be compiled for future guidance. Having said so much with regard to the chief points which have suggested themselves in connexion with forest administration, legislation, and management as applicable to India, and regarding which, I think, I learnt not a little during my tour, I proceed to refer to the establishments employed.

German forest officers and their attainments.

Nothing that I can say or write can convey too high an idea of the attainments and thorough knowledge of their work possessed by German forest officers of all grades. I confess that prior to and during the first few weeks of my visit I was inclined to class a great deal of German forestry as much theory and little practice, and perhaps mountains are sometimes made of molehills, and more is written than the subject demands or justifies, but this may be said with

equal truth of every science or profession, and a very little time served to convince me that the practice of the German foresters was as good, if not better, than their theory, and that they were in fact perfect masters of their duties in all their details. An Oberförster, and even many of the Försters and overseers, can tell the name, local and botanical, of every tree, shrub, and plant, classify it, and state its uses; name and classify every beetle and insect in the forest, and know whether they are harmless or destructive to trees, in what shape they do damage, and what are the best known preventive measures; inform you of the nature of the soil, and to what period the formation belongs, what trees will grow best, and why. All this is known thoroughly, theoretically and practically.

Then as to the revier, the exact yield, rate of growth, and annual increase in value of each block is thoroughly known and can be put down at any moment in figures by the *Oberförster*, who can tell at the commencement of each year how much timber he is going to cut and sell and from what parts of the forest it is to come, how many acres have to be partially cleared for natural reproduction, planted, sown, thinned, or planted up.

The mere details of all this are left, as a rule, entirely to the subordinates, who thoroughly understand them.

The *Forstmeisters* in charge of divisions possess not only the theoretical and scientific knowledge acquired in the forest academy, and the practical experience gained whilst they were *Oberförsters* in charge of a revier, but the more extended knowledge and wider views from their larger field for observation and comparison of causes and results. They are thus qualified to decide most points, revise working plans, and supervise operations generally, whilst settling complaints and complications in connexion with the forest administration, advising the local head of the department, and compiling valuable reports and statistical information.

On the onerous duties of administration, legislation, and working of forestry in its most extended sense, which devolve on the higher grades, such as *Direktors, Ober-Forstmeisters, Oberland Forstmeisters,* and *Forst Räthe,* I need say nothing more than that all those with whom I had the honour of coming into contact appeared thoroughly at home, not only with their particular duties and branch, but with all the details of State forest administration and management. In a word, the longer I remained the more I saw and felt how little I knew of the subject compared with those I met occupying similar or analogous positions in the forest service; and if the highest wisdom with regard to forestry is to know

that you know nothing, I think I arrived very near it before my return to England.

I venture, however, to offer a few suggestions for the benefit of any of our forest officers who may be inclined to visit the German forests in future.

Suggestions to forest officers visiting Germany.

I think there are very few, unless they are Germans by birth, or have constantly kept up their German studies, who would find that they could with advantage attend a course of lectures at one of the academies without more than two months' previous residence and study of the language and forest technicalities. I am therefore inclined, with all deference to Dr. Brandis' suggestions, almost to leave that out of consideration in sketching in what way time can be best utilized.

Long course, 10 to 12 months.

To those who do wish to go through such a course, and I am certain they will never repent it if they have sufficient time and knowledge of the language, I should say go to Hanover in September, and have at least one month in a revier before going to the academy. I do not think any revier could well be better suited for the purpose than Lauterberg. The winter term at Tharandt commences on the 15th October, and that at the Prussian academies (which I presume are also open to forest officers) and Aschaffenburg about the same time. Spend the winter at the academy, and by the end of April proceed for at least another six weeks to a revier, and apply what has been learnt and then devote another six weeks or two months to travelling through other forest districts and comparing the management and system in each. This course would occupy at least 10 months, and I do not imagine many forest officers on leave will be prepared to devote so much of their time to the subject.

Short course, 3 to 6 months.

For those who could only devote a short time comparatively to the duty, or do not feel themselves sufficiently proficient in the language to benefit by a course of lectures, I would prescribe residence on a forest revier during six weeks, visiting other reviers in the same kingdom or province a fortnight, and travelling through the forests of other countries one month, making three months in all; and, if this time could be prolonged, I should advise a longer residence in the one revier. Dr. Brandis strongly recommended me to confine my attention for the most part to one province or portion of a province, and I cannot say I actually learnt much in the shape of practical forestry after I left Hanover, always excepting the felling and transport of timber in the Black Forest, which require to be seen to be understood and well repays a visit. I acquired much useful information in the other kingdoms, a great part of which, however, might be obtained from books.

It is difficult to say at what season of the year it would be best to commence the short course, but I am inclined to say not earlier than April, as the climate in North Germany is very raw and severe, and few forest operations can be carried on when the ground is covered with snow, although I did miss a forest survey in Hanover by not arriving even sooner than I did (the middle of March), which I much regretted. It is impossible in so short a time to see everything, and if you are at Hanover in the proper season you will be at Rippoldsau when comparatively little is going on, and *vice versâ*.

Difficulties and discomfort to be expected at first.

Above all let no forest officer imagine he is starting on a mere pleasure trip, and will find everything *comfortable* and to his taste. He will find there is a great deal of roughing it in a shape which I think the most difficult to accommodate oneself to, strange and unpalatable food, want of cleanliness and comfort, and a perfect change in the mode of life, habits, and associates to what one has been accustomed to in England. I would particularly counsel the undertaking of no tours or expeditions until a little shaken down, at home with the language, and accustomed to the mode of life and style of food and lodging to be met with in a German village inn. I mention this as I spent much valuable time in making such tours at the outset, and derived little or no benefit.

Again, visitors must expect to be shown the same thing over and over again, which, although tiresome and seemingly useless, does good, I am convinced, in the end in firmly impressing things on one's memory.

I append tabular statements showing the extent under forest in proportion to total area, population, &c. in the principal German states, the figures in which are taken from *Bernhardt's Forststatistik Deutschlands*, to which work, *Die Forst Verwaltung Bayerns*, and Director Burckhardt's publications, I am indebted for much valuable information.

SPECIMEN OF HEADINGS INTO WHICH THE SKETCH OR PREFACE OF WORKING PLAN MAY BE DIVIDED (referred to at page 7).

PART FIRST.—Existing arrangements and circumstances of the forest.

1. Extent and situation. 2. Measurements, when and by whom taken, &c. 3. Boundaries. 4. Roads. 5. Local conditions, communal rights and privileges, and present state of the forest. 6. Yield and disposal of the produce.

Part Second.

(*a.*) General working plan proposed.

1. Description and class of timber to be grown and with what object in view. 2. *Umtrieb* or rotation of crop, which varies according to description of timber, and whether grown as *Hoch*, *Mittel*, or *Nieder Wald*. (See note below). 3. Division and subdivision of the forest with reference to the *Umtrieb* and *Umtrieb Zeit*.

(*b.*) Special working plan or regulations proposed.

(1.) 1st. Complex treatment of the oak Hochwald.
2nd. do. do. of the beech do.
3rd. do. do. of the oak and beech *Mittel* and *Nieder Wald*.
4th. do. do. of the spruce and Scotch fir Hochwald.

(2.) The *état* or estimated annual yield of the several complexes and of the whole forest.

(3.) Improvement of the forest, soil, roads, &c., noting the leading points to be attended to during the next 20 years, *e.g.*—

a. Pushing on the construction of roads in certain parts.

b. Planting or sowing up vacant spots now unproductive.

c. Removal of the worthless or less valuable descriptions of trees in certain blocks, and planting of spruce and fir. Further planting of clearings where the natural reproduction has more or less failed (specifying the exact localities in both instances).

d. Thinning, particularly in the mature and too thickly covered portions (to be specified), &c. &c.

Part Third.—General and concluding remarks explanatory of the accompanying detailed working plan and maps for the guidance of the executive.

Note.—It is difficult to find exact synonyms for many of the German forest terms, but the following, as used by Dr. Brandis, may be adopted:—

*Hoch-wald - -	High timber forest or high forest.
Mittel-wald - -	Coppice, with standard trees.
Nieder-wald - -	Coppice.
Umtrieb - - -	Rotation.
Umtriebs-zeit - -	Length of rotation.
Einrichtungs / Wirtschafts } Plan -	Plan of operations, or working plan.
Oberförsterei or Revier - -	Forest district or range managed by an ober or revier förster.
Forst-bezirk - -	Forest circle or division supervised by a Forst-meister.
Massenaufnahmen -	Forest valuation surveys.
Vorbereitung's Schlag, Besammung's ,, , Dunkel ,, , Licht ,,	Terms applied to the several stages of clearing for reproduction.

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* The term is used to denote plantations or woods, at any period of their growth, which are to be left till mature, whether for timber or firewood supply; which are to be reproduced from seed, and in which the mature wood will constitute the chief object (*Haupt nutzung*); whereas in Mittelwald the coppice is equally if not chiefly the aim.

STATEMENT showing the FOREST AREA in proportion to the total extent and population in six of the largest GERMAN STATES and in the whole GERMAN EMPIRE.

1	2	3	4	5	6	7	8	9
Name of State.	Extent in Hectars.	Population per latest Census.	Extent of Forest.			Proportion of Forest to total extent per 100 Hectars.	Forest area per head of Population.	Remarks.
			Under State Management.	Private.	Total.			
			hectars.	hectars.	hectars.	hectars.	hectars.	
Prussia - -	34,831,924	24,019,567	3,803,388	4,333,965	8,137,353	23·4	·339	The hectar is 2·4711431 English acres.
Bavaria - -	7,585,738	4,824,421	1,332,962	1,263,869	2,596,831	34·4	·536	The sources of information made use of in compiling this statement are, Leo's Forst Statistik, Die Forst Verwaltung Baierns, Bernhardt's Forst Statistik.
Wurtemberg -	1,950,597	1,778,396	399,169	195,933	595,102	30·5	·335	The forests classed as under State management (col. 4) include State, communal, and ecclesiastical forests.
Baden - -	1,530,967	1,434,970	349,267	161,657	510,924	33·4	·356	I have retained the *hectar* in this statement, as it is the land measure now universal in Germany, and supersedes the various *morgens*, *ackers*, and *tagwerks*, which were formerly so perplexing.
Saxony - -	1,496,644	2,423,401	192,370	280,049	472,419	31·6	·195	
Mecklenburgh Schwerin.	1,344,078	560,618	115,321	48,246	163,567	12·2	·292	
German Empire	54,102,769	40,089,170	7,247,862	6,692,679	13,940,541	25·7	·348	The total area per head of population in the German Empire is thus 1·3 hectars, of which ·348 hectars is woodland.

STATEMENT showing the actual extent of purely STATE FOREST in some of the GERMAN STATES and the AUSTRIAN EMPIRE, with the yield per Acre, and explanatory Remarks.

1	2	3	4
Name of State.	Area of Purely State Forests, in English Acres.		Yield per English Acre, calculated on Column 2.
	Productive.	Unproductive.	
			cubic feet.
Prussia - -	5,836,100	666,175	34·5
Saxony - -	378,555	15,614	72·5
Bavaria - -	2,079,835	238,788	63
Wurtemberg -	469,087	—	84·7
Baden - -	212,770	18,817	80·6
Austrian Empire	1,576,699	653,347	41

5

REMARKS.

The figures for Prussia, Wurtemberg, and Baden are taken entirely from *Bernhardt's Forstatistik* (1872); for Saxony, from the *Tharander Forstliches Yahrbuch* (1870); and for Bavaria, from the *Forststatistische Mittheilung* (1869). The unproductive area in Wurtemberg is not given by Bernhardt. For Austria I have taken the figures given in the latest annual report. From this table the average yield of the Prussian State Forest would appear low in comparison with other States, and there is no doubt that, owing to circumstances of soil and climate, the yield is below that of Saxony and Bavaria and the Black Forest. The great extent of the Prussian Kingdom must be taken into account, but still more the accurate nature of the statistics, which are for the year 1871, whilst those for Wurtemberg are for 1860, and Baden, 1856, no later data being given by Bernhardt. The yield in Prussia is greater in the western than in the eastern provinces, and varies very widely; thus we have the provinces of Danzig and Marienwerder with a yield of only 20 cubic feet per English acre; Bromberg, Minden, and Cöslin with 23; whilst Hanover, Aachen, and Wiesbaden are all over 50, and Erfurt 56·5 cubic feet. Again, the areas in columns 2 and 3 are classed for Prussia as "devoted to the rearing of timber," and "not devoted to the rearing of timber," and I imagine that under column 2 a considerable extent of moor and really uncultivated area is included, whereas in the smaller States (Wurtemberg and Baden) only the area actually under crop is taken into account. For these reasons I am inclined to reject the figures for these two States altogether. The Austrian yield is also very doubtful, and the large proportion of unproductive to productive area is a noteworthy feature. As regards Bavaria, the system of calculation in "*klafters*" and "*wellenhunderts*" makes it difficult to arrive at accurate results, and I may mention that Bernhardt makes the Bavarian yield only 45 cubic feet per acre. For Saxony I believe the figures to be accurate, and there is no doubt that the Saxon yield is high, and steadily increasing, having been 60·4 cubic feet in 1854, 67·6 cubic feet in 1863, and now (1870) 72·5 cubic feet per English acre. Even with regard to this State, however, there is an element of uncertainty in the figures given, as Judeich, in Table 1 of the Jahrbuch, gives the yield first as 1·23 klafters of 100 cubic feet per Saxon acre, = 89 cubic feet per English acre; and, second, 5·04 forst-metre per hectar, = 72·5 cubic feet per English acre, which latter figures I have retained as above.

II.

Report by Captain Campbell Walker, Staff Corps, Deputy Conservator of Forests, Madras, on English and Scotch Forests, dated 15th March 1872.

CROWN FORESTS.

Introductory.

The Royal forests and woodlands which I have visited, on the authority of the Commissioners of Her Majesty's Woods, Forests, and Land Revenues, are the Windsor Great Park and Sandhurst Woods, the New Forest and Parkhurst Woods, and the Dean Forest and High Meadow Woods. The two former are not included in the summary of woods and plantations published in 1863, in which the total area or extent actually under timber in the woods and plantations is given at 51,606 acres, of which 11,923 are natural woods or planted before 1800, and the balance of 39,687 acres have been planted since 1800. Since 1863, a considerable extent must have been added to this area, and the Sandhurst Woods, if not those of Windsor Great Park, ought to be included.

Besides the forests visited by me, the above acreage includes the woods or plantations known respectively as Alice Holt, Woolmer, Bere, Delamere, Salcey, Hazleborough, and Chopwell, none of which, however, extend over 3,000 acres, the majority being only small pieces of 1,000 acres under crop.

The receipts from the New and Dean Forests, High Meadow, Bere, Alice Holt, Woolmer, and Delamere Woods, for the year 1870–71, aggregated 37,390*l.*, whilst the expenditure amounted to 22,230*l.* I did not obtain the figures for Salcey, Hazleborough, or Chopwell Woods, and Windsor Great Park cannot, as hereafter explained, be regarded from an ordinary financial point of view.

The bulk of the Crown forests consists of oak, which, however, particularly in the New Forest, is now gradually being replaced, when mature and felled, by the larch, Scotch fir, and other conifers.

The extensive oak plantations were made under the direction of successive Acts of Parliament, which in most cases expressly declare the object to be the providing a supply of oak timber for the navy. This necessity has now, to a great extent, ceased, as our "wooden walls" are things of the past, and teak is much preferred to oak for the backing of iron-

clads, the juice of the oak having, I am informed, an injurious effect on the iron, which is not found to be the case with the teak. The value of the oak bark has also much decreased of late years, owing to the adoption of other substances for tanning, and large imports of foreign bark.

Still the value of the timber in the Royal forests and woodlands must be very great. It was estimated in 1849 as 1,087,777*l.* for the enclosed plantations made since 1808 alone, and the value of the same plantations when at maturity was then estimated at 10,000,000*l.* If to this be added the woods and plantations which existed prior to 1808, and those which have been formed since 1849, it will give some idea of the valuable property administered by Her Majesty's Commissioners and the forest officers of the Crown.

It is, however, scarcely necessary to point out how much more valuable and deserving of care and attention is the forest property of the State in India, where the extent may be considered as miles for acres, on the most moderate computation, and the climatic considerations and the agricultural wants of the people give to the subject of forest conservancy a special interest beyond what it demands in this country, where the climate is temperate, rain-fall plentiful, and iron and coal take the place of wood for many purposes to which the latter is adapted, and for which, in fact, it forms the sole resource in India.

I beg here to express my thanks to the Deputy surveyors of the several forests, their assistants, and all with whom I have had the honour of being officially brought into contact during my visits to the forests, for their kindness and civility, and the anxiety which they have uniformly evinced to afford me every information and assistance in their power, even, I fear, in some cases, to their own inconvenience and discomfort. I cannot too strongly express my appreciation of the kind manner in which I was received as a brother forester.

Windsor Great Park and Sandhurst Woods.

I went round these woods with Mr. Menzies, the deputy surveyor, but as they are avowedly more ornamental than profitable I do not purpose submitting any detailed report on them.

Oak Woods.—The plantations in the park are mainly oak, which attains a great size; of late years there has been considerable planting of *coniferæ* in clumps for ornamental purposes.

The plantations known as the Swinley Woods are the finest and most extensive, and present a uniformity and evenness of growth which can only result from the most careful training from the day they were planted out.

"*Stag-headed*" trees are very rare, the greatest care being taken, and certainly with marked success, to encourage and help the tree to preserve one leading shoot. The manner in which this is effected is the more remarkable, as Mr. Menzies disapproves of pruning as practised in the Scotch forests, and relies mainly, I might almost say entirely, on careful training, by judicious thinning and allowing each tree to stand on its own ground and then make its own way.

Scotch Fir Woods.—The Scotch fir woods, which are chiefly self-sown, are extensive, and contain a very fine supply of timber.

They are situated for the most part in the vicinity of Sandhurst, and interspersed here and there with patches of beech.

Mr. Menzies finds it best in felling the fir to clear out patches only, leaving belts of mature trees standing. This facilitates, and in fact provides for natural reproduction, and affords shelter to the young trees as they grow up.

Workshops.—The workshops, containing saw machinery of every description, are particularly deserving of note, although constructed on too expensive and extensive a scale for practical adaptation for our purposes. The late Prince Consort took a special interest in them, and personally superintended much of the work, and the workshops now bear his name.

The general management and growth of the timber trees are such as will repay a visit, although this Crown forest must not be considered from an economic point of view, and there is now no planting carried on save for ornamental purposes.

The extent under crop is difficult to ascertain, owing to the scattered nature of the plantations and woods, and it is not stated in the Return of Royal Forests and Woodlands made by order of the House of Commons in 1863, which contains the acreage, &c. of all the other Crown forests.

In fact, the circumstances of these woods are quite exceptional, as appertaining to the Royal residence at Windsor, and constituting the recreation ground of the Sovereign and public.

The total receipts for 1870–71 were 7,484*l.*, while the expenditure amounted to 20,613*l.*

The New Forest.

Extent and Divisions.—The New Forest in Hampshire now contains about 91,000 acres, and is divided into three districts, each under the immediate charge of an assistant to the deputy surveyor, who, acting under the orders of the Commissioner of Woods, supervises and manages the whole.

The forest is situated to the south and south-west of Lyndhurst (about three miles from Lyndhurst Road railway station), where Mr. Cumberbatch, the deputy surveyor resides.

Of the total extent of 91,000 acres only some 2,000 is the absolute property of the Crown. As regards about 26,000 acres, the soil is the property of private landowners, whilst with regard to the remaining quantity of about 63,000 acres, the soil and freehold is the property of the Crown, which has also certain forestal rights and rights of enclosure and planting, subject to which numerous persons are entitled to and exercise certain rights which I propose to detail more fully in a special section devoted to their definition, and the steps which have been taken from time to time for their settlement or commutation.

Nurseries.—I visited an extensive nursery well stocked with young trees of all descriptions at Rinefield; it extends over 40 to 50 acres. There is another of smaller extent at Perry Hill, which I did not see, and there are several small ones in various parts of the forest, adjoining the places where planting is being, or about to be, carried on. Mr. Cumberbatch is in favour of transplanting for the last time into a nursery near the ground to be planted, and this would appear an excellent idea. In India, indeed, it is almost a necessity, as our young trees will not bear being carried any distance, in the plains at least.

Hitherto our planting in Madras, with the exception of the Nellambur teak planting, has been comparatively of small extent, but as the area of the plantations increases it will, I think, be found necessary to have similar subordinate nurseries, so that the trees to be put out may be ready at hand. The management of the nurseries differs in no way from that described in my Report on the Scotch forests, and the varieties reared are identical.

Plantations.—I visited eight plantations of dates subsequent to 1835, viz., Lady Cross, Whitley Ridge, Hawkshill Enclosure (where they were planting with the planting spade),

Rinefield Walks, Islands Thorns, Highland Water, Slufter, and King's Garn Gutter.

The plantation known as Islands Thorns extends over nearly 500 acres, and was planted with Scotch fir and larch as nurses in 1853, and with oak in 1857. Mr. Cumberbatch finds it an improvement to plant out the nurses a few years before the hard wood trees, in order that they may be established, and find the necessary shelter from the winds, which are often very high and cutting. This plan appears to answer well when applied with judgment; otherwise the nurses, on good soil, would have made such progress as to interfere injuriously with the growth of the hard wood trees.

The Highland Water plantation, with an area of 700 acres, was planted in 1869 and 1870. It is Scotch fir, and contains also a portion of some old wood planted in 1700. The growth of the fir is not rapid, but the trees look healthy, and there have been few casualties.

In the Slufter enclosure of 370 acres, the Scotch fir and oak, planted eight years ago, are doing very well, particularly in the lower portions of the plantation where the soil is of a tolerably good character.

King's Garn Gutter contains upwards of 300 acres, and has just been finished so far as the nurses are concerned. They are Scotch fir and larch, in lines eight feet apart and six feet in the rows. This is to be filled up with oak, which is now ready in the adjoining small nursery, on the system already described.

This land was formerly covered with a fine crop of oak, which was felled some years ago. The planting is done in the usual manner by day labourers under the superintendence of a foreman and the assistant.

There is a very fine arboretum at Bolderwood Rails, containing specimens of many varieties of *Pinaceæ*, such as *P. Douglasii, insignis, nobilis, Cupressus Lawsoniana*, &c., &c., and a large number of Deodars, which are doing very well on the higher and more exposed situations.

The trees are from 10 to 15 years out, and present a very healthy and pleasing appearance.

Woods.—I visited 10 different woods or enclosures of dates prior to 1835.

The oldest are known as Mark Ash, Burley, South and North Bentley, Salisbury, and Coppice of Linwood.

The Mark Ash old wood is principally composed of beech, of which there are magnificent specimens.

Burley contains a mixture of oak and beech, the former sown with acorns in 1700. One fine old tree, known as the Knight Wood Oak, is estimated to contain at least 13 loads, or 650 cubic feet of timber.

The South and North Bentley Woods contain a great proportion of the *sessiliflora* variety of oak, from acorns sown in 1700. The growth is considered fair throughout, but particularly good in the bottoms, which are sheltered from the prevailing winds.

The Coppice of Linwood contains what are known as "Pitt's plantations," so called from a Mr. Pitt, who was Surveyor General in 1775. These extend to nearly 300 acres, consisting of oak and beech, with clumps of Scotch fir, which appear to have been planted subsequently. The hard wood trees are very poor, having been planted out without nurses, and much too far apart. In the adjoining enclosure of Salisbury the trees are much better, owing to their having been planted much thicker.

Of the younger woods I would particularize Aldridge Hill (1818), an oak wood with a belt of self-sown Scotch fir round the outside. Holm Hill (1821), extending over 285 acres; a fine oak plantation, with trees in the hollows or low-lying plantations running from 30 to 40 feet in height.

Here I observed some fine larches, which had been felled, owing to the commencement of dry rot, to which this tree appears very liable in the New Forest.

The paths and rides in the forest are well maintained, but in many places it is impossible to secure a firm roadway, owing to the boggy nature of the soil; more draining will be required as more enclosures are made and plantations formed.

The total revenue derived in 1870–71 amounted to 12,034*l.*, and the expenditure to 7,790*l.*, leaving a balance of 4,244*l.* in favour of the forest.

Fencing.—Mr. Cumberbatch has adopted a very substantial and neat style of fencing, which I have not seen in use elsewhere. A ditch, 2 ft. 6 in. deep and 4 feet wide at top and 2 feet wide at bottom, is excavated, and the earth thrown up inside, forming a bank of similar dimensions. On the top of this stakes are driven firmly in at intervals of six feet, on which are nailed bands of hoop iron about one inch broad, which is procured in lengths of 12 feet at a cost of about 11*l.* per ton. There are either two or three rows, according to the situation, and the lengths finish on alter-

nate posts, so as to ensure greater stability; thus, of two rows, the end of one length and the centre of the other would be secured to each and every post. The hoop iron and posts are thickly coated with tar, and there is a great advantage in no straining being required as with ordinary wire fencing, compared with which it has also the advantage of being much stronger, as noted in my Report on the Scotch Forests in the section devoted to this subject. The average cost complete is found not to exceed 1*s.* per running yard, which appears very moderate when we consider the rates of labour, the strength and neatness of the fence, and its great durability. The iron may, of course, be said to last for ever, and on any enclosure being thrown open, as described further on, can be used again elsewhere.

Short History of the New Forest.

I proceed to give a short history of the origin of this forest, with a description of the position of the Crown with regard to it, and of the principles by which its management has been controlled and guided. Such cannot fail to prove interesting and instructive to our officers, many of whom are now called on to deal with such subjects as rights of common, of pasturage, forestal rights of the Crown or people, &c., &c., for the first time. I must premise that I am much indebted to Mr. Cumberbatch for information on the subject, and particularly for his having kindly placed at my disposal for perusal three returns or reports on the subject, which deal with the whole matter *in extenso*, and copies of which I have since procured on payment. They are,—

1st. A return to an order of the honourable the House of Commons, dated 23d March 1863, containing a Statement on Royal Forests and Woodlands, ordered by the House of Commons to be printed on 24th April 1863, of which I have prepared an abstract to facilitate reference.

2nd. A return to an address of the House of Lords, dated 21st February 1868, containing copy of a Report on Royal Forests, ordered to be printed 10th March 1868. And,

3rd. A return to an order of the honourable the House of Commons, dated 16th June 1871, containing copy of a Report by the Hon. J. K. Howard, Commissioner of Woods, on the New Forest, ordered by the House of Commons to be printed 16th June 1871.

The above are parliamentary papers, and can be easily obtained.

I forward also an abstract statement of the extent of Royal Forests, &c.

The New Forest was afforested by William the Conqueror, and was at one time of much greater extent than it is now. It must not, however, be supposed that there was therefore a greater quantity of timber, or extent of what we now understand by the word forest; on the contrary, I believe that it is all but indisputable, that there is now a greater stock or crop of useful timber, or what will eventually become useful timber, than at any former time. It cannot be too clearly borne in mind that the original meaning or signification of a forest in England was nothing more than a park for deer, a meaning which we still find attached to it in Scotland, where we have deer forests without a tree in them, so to speak.

The words "afforesting," and "disafforesting," are also apt to mislead an amateur or novice, and the latter has, I believe, been misunderstood by at least one of our forest officers, and treated as synonymous with disforesting, i.e., clearing or destruction of forests, or the trees which constitute the forest as we now understand the word, whereas, in reality, the disafforesting of the so-called Crown forests in this country is the first step towards their conservancy, as timber producing areas.

Disafforestation, in short, means a separation of the rights of the Crown and the commoners, and appears to be exactly what is required in Madras to put an end to any doubts as to the legal status of the forest department, or clashing betwixt the Government, through its officers, and the people or commoners. The arguments in favour of a disafforestation are stated clearly and forcibly at page 9 of Mr. Howard's report of 1871, and appear to be equally applicable to India. After alluding to the financial considerations resulting from the possession of forestal rights over a large extent not in the exclusive possession of the Crown, which "undoubtedly entails upon the Crown a large "amount of unremunerative expenditure in management "and supervision which would be saved if the Crown rights "were commuted for an allotment in severalty," Mr. Howard proceeds to point out how much the value of the property or rights would be increased to each party by their being definitely separated and divided, and concludes, "But these

" considerations are of scarcely so much importance as that " of the unsatisfactory position which the Crown occupies " with reference to those who have rights over the " forest, which rights are subject to the paramount rights " of the Crown, and the difficulty which is experienced, " under the existing arrangements, of guarding and en- " forcing the Crown rights, and of watching, controlling, " and regulating the conflicting and intermixed rights of " others, without creating ill-feeling, and exciting hostility " towards the Crown and its representatives."

I proceed to state briefly the steps which have been taken towards "disafforestation" and commutation of common rights in the New Forest.

As stated under the section devoted to "Extent and Divisions," the total area of the forest may be stated as 91,000 acres, but of this only 2,100 acres is freehold of the Crown, and even of this extent 668 acres are let to tenants, and a considerable portion occupied by the Queen's house at Lyndhurst, lodges within the forest, &c., leaving the actual area of freehold forests or plantations, over which there are no common rights, as little more than 1,000 acres.

Again, 26,000 acres are the property of private landowners. On this point there is some little ambiguity or discrepancy in the reports alluded to. In No. 1 it is distinctly stated that "the Crown has no right to enclose or plant such land " or to keep deer thereon; both the soil and the timber " are the property of private landowners." In No. 2, the 26,000 are described as "private property subject to the " forestal rights of the Crown;" and in the third and last report it is merely stated that "as regards about 26,000 " acres of that quantity (the 91,000 total area), the soil is " the property of private landowners." I shall not, therefore, attempt to describe or allude further to those 26,000 acres, and turn to the remaining 63,000 acres, of which the soil and freehold is the property of the Crown, in which the Crown has also certain forestal rights, and certain rights of enclosure and planting, under the authority of Acts of Parliament passed in 1698, 1808, and 1851, but in which, subject to these several rights, numerous persons are entitled to and exercise certain rights.

The forest, as already stated, was formed as a deer park by William the Conqueror, but certain of the neighbouring proprietors and their tenants appear always to have exercised certain rights or privileges within its limits.

These rights may be stated as,—

1st. Common of pasturage, to take, by the mouths of the commoners' cattle, so much pasturage as was left after providing food for the sovereign's deer.

But this right was hampered with an obligation on the part of the commoners to remove their cattle during "the fence month" (viz., from 20th June to 20th July) and "winter hayning" (viz., from 22d November to 4th May), in fact, for six months out of the twelve. Again, it must be borne in mind that the right of the Crown to keep an unlimited stock of deer was paramount to the right of the commoners, and that, if the number of deer were indefinitely increased, the commoners' right to pasturage during six months of the year would become virtually of no value.

2nd. Common of mast (feeding of pigs) from 25th September to 22d November.

3rd. Common of turbary (cutting turf), "to be exercised "by the view and allowance of the foresters of "the forest."

4th. Certain rights of fuel, and getting marl from the forest.

The first legislation which we find recorded on the subject is in the reign of William the Third, when Act 9 & 10 Will. 3. c. 36, afterwards called "the Act, 1698," was passed, empowering the inclosure of 2,000 acres, part of the waste lands in the New Forest, "as a nursery for wood and "timber only," and further authorising the inclosing of 200 acres yearly for 20 years for a like purpose, and providing for all such inclosures being thrown open again whenever the trees were "past danger of browsing of deer, "cattle, or other prejudice," and that, in lieu of so much as should be laid open, "a like quantity might be inclosed, and "holden free of all manner of common herbage, pannage, "or other rights, for so long a time as the same shall re-"main and continue inclosed, to be a nursery for timber "only."

This Act and its working forms frequent subject of comment in a report of the Royal Commissioners, dated 22d July 1789, from which we learn that the powers vested in the Crown by it had not been exercised, and only 3,300 acres had ever actually been inclosed, whereas, if the 6,000 acres had been inclosed and planted during the first 20 years after the passing of the Act, and the enclosures thrown

open when the trees were at 20 years' growth, there would have been at the end of the 90 years which had elapsed when the Commissioners wrote, "at least 24,000 "acres of land formerly bare which should now have been "covered with trees."

In 1808, an Act, 48 Geo. 3. c. 72, was passed, "for the "increase and preservation of timber in the New and "Dean Forests," authorising the inclosing of 6,000 acres, including the portions already inclosed, and providing for portions being thrown open from time to time, and others inclosed in lieu thereof.

In 1819, an Act for enforcing the right of the Crown to exclude cattle during the winter season, or "hayning time," became law; and in the session of 1848, a Select Committee of the House of Commons was appointed, "to inquire into "the management of the Crown property."

In 1849, a commission was appointed, of which Lord Portman, and Messrs. Dampier and Daly, barristers-at-law, were members, who reported in favour of the removal of the deer from the forest.

This Report, and the discussion which ensued, led to the introduction of "An Act to extinguish the right of the "Crown to keep deer in the New Forest, and to give com-"pensation in lieu of such right," which eventually became law, and is known as the Act of 1851. By it the Crown acquired the right, in compensation for that of keeping an unlimited number of deer, of inclosing 10,000 acres, for planting purposes, to be thrown open when the trees were sufficiently advanced to be out of harm's way, and portions of similar extent inclosed, and, in accordance with its provisions, the deer were removed, and inclosures amounting to about 5,000 acres have been made, or are in the course of being planted. To quote Mr. Howard again,—"The pro-"visions of the Act of 1851 were and still are regarded by "the officers of the Crown as in the nature of a statutory "compact between the Crown and the commoners. It is "considered that the commoners are bound by the Act, and "that an alteration of its provisions cannot take place "without the concurrence of the Crown." Mr. Howard then proceeds to show that the conditions of the Act have not been fully carried out; that, so far as the commoners are concerned, they are in the full enjoyment of all, and more than all, the benefits secured to them by the Act. The deer have been removed, and each commoner's right investigated and entered in a register, but the Crown is not yet in possession of even the immediate compensation secured to it by

the Act, for it has only inclosed one half out of the 10,000 acres.

The difference betwixt the immediate and the full compensation, as pointed out by Mr. Howard, should not be lost sight of. The immediate compensation was the right to inclose 10,000 acres of the waste, the full compensation was, not only the right to inclose 10,000 acres, but the right to throw open such inclosures from time to time, and inclose and plant other portions of the waste of the forest in lieu thereof.

In 1854, Messrs. Matthews, Murton, and Menzies reported in favour of inclosing the entire forest, and in 1868, consequent on petitions complaining of the mode in which the provisions of the Act of 1851 had been carried out, a Select Committee was appointed to inquire into the matter. They recommended "the employment of a commission for the "purpose of allotting to the Crown certain portions of the "forest in fee, freed of all common rights, and leaving "the residue to the commoners, to deal with in such manner "as they may think best."

A Bill to this effect was prepared and introduced into Parliament last session, but withdrawn, owing to the pressure of other business. Thus matters at present rest, on what cannot be considered a satisfactory footing; for, it would appear, that the more the commoners have yielded to them the more they ask for, and that the Crown, that is the nation, and public at large, are worsted, and do not secure the benefits agreed to from time to time in lieu of the concessions made.

Mr. Howard tells us that, of the 63,000 acres of which I have now been writing, "about one half consists of land of "a good or tolerably good character, while the other half "consists of sandy and heathy or boggy land of an inferior "description."

About 5,000 acres are covered with old timber, about 8,500 acres by trees planted under the authority of the Acts of 1698 and 1808, in inclosures now thrown open according to the provisions of the Acts, and about 11,000 acres have been or are being planted in existing inclosures under the provisions of the Acts just referred to and that of 1851. This makes 24,500 acres out of the 63,000 covered with plantations or trees of various ages.

It cannot be too clearly borne in mind that the pasture is very much improved by the planting of trees. I have noticed this in the Report on Scotch Forests, and observed it again in the royal forests. The larch in particular has a wonder-

fully fertilizing effect. The shelter afforded by the trees must not either be lost sight of. One is indeed at a loss to conceive why the commoners do not see that it is vastly to their interests that land, almost valueless for any other purpose, should be enclosed, planted at the expense of the State, and thrown open again with the pasturage vastly improved, in fact in some instances created for their benefit, but such is the tenacity with which they resist any such temporary inclosures, or anything approaching to what they consider, rightly or wrongly, an infringement of their rights, that one ceases to wonder at the objections raised, under very similar circumstances, by the natives of India against measures of conservancy devised really and solely for their welfare and that of the community at large.

The rights of the commoners in the New Forest have been very carefully inquired into, and entered in a register, which forms a most valuable reference for the officer in charge. It includes about 860 proprietors and their tenants. Many of the rights are subject to a payment, generally of some nominal amount, failing which they remain in abeyance, and, I presume, are forfeited after a certain time has elapsed.

Mr. Howard states that for the last three years (prior to 1871) only 937 loads (about 46,850 cubic feet) of oak and beech timber have been felled annually, which is equivalent to about one load from every 67 acres. In order to satisfy the fuel rights of persons legally entitled to them, it is necessary to provide 389 loads of timber each year, and for that purpose to fell about 330 beech trees. I presume that this is over and above the 937 loads mentioned before.

There are four verderers of the forest elected by the freeholders of the county of Hants, whose duty it is to stand between the Crown and the commoners, and adjust any differences which may arise. They represent the commoners, but are public servants, and, if I mistake not, receive some small salary or emoluments from the State. They hold periodical meetings in the Verderer's Court adjoining the Queen's House at Lyndhurst, but Mr. Cumberbatch informs me, have not, as a rule, many cases or disputes to consider and settle. In fact, it struck me not a little how much confidence and cheerful acquiescence was shown in the deputy surveyor and his decisions and orders by all classes of the community, and the apparently utter absence of that clashing of departments of which we see so much in India.

In addition to the Court of Verderers, there is a commission appointed under the Act of 1851 to set out the 10,000 acres of inclosures, and see that the other provisions

of the Act are duly carried into effect. This commission consists of 13 members, "of whom six are justices of the "peace for the county, four are gentlemen possessing pro- "perty in or near the forest, who have been elected by the "freeholders of Hants to be verderers of the forest, and "the remaining three are the two Commissioners of Woods "and the Deputy Surveyor of the Forest."

Probably similar mixed commissions will eventually be constituted in India for similar purposes. Indeed they differ but slightly from those proposed in the bill recently introduced for the better management of our Indian forests.

I must now conclude this brief and imperfect description of the New Forest, and of the position of the Crown with respect to it, &c., &c., and again recommend to our officers a careful perusal of the reports and returns already mentioned, which clearly show the principles of management which have been adopted from time to time, and that our *confrères* in charge of the State forests in this country have enjoyed no immunity from the troubles, and, what one is apt to classify as vexatious opposition, which we meet with in India.

Parkhurst Woods.

These woods, situated in the Isle of Wight, extend over about 1,200 acres, and are under the charge of Mr. Gulliver, as foreman or head forester, acting under the orders of Mr. Cumberbatch, the deputy surveyor, who has also charge of the Bere, Woolmer, and Alice Holt Forests.

The Parkhurst plantations are freehold of the Crown, and were commenced about the year 1814, under the authority of an Act of 1812, which applied also to other woods, and set forth that "it had become necessary to adopt measures "for securing a more adequate supply of timber in the "kingdom," and directed that the "inclosure to be made by "the Crown under its authority should be made and reputed "a nursery or nurseries for wood and timber only."

The soil is chiefly a cold stiff clay, with gravel on the hills, and is very badly suited for the growth of oak, with which it appears to have been originally planted for the most part. Some of the oak first planted on the upper and drier portions of the land is doing fairly, but elsewhere the growth is stunted, and the trees stag-headed and gnarled. The beech, chestnut, and stone pine exhibit also a fair growth, but the larch planted about 14 years ago is flourishing, and, in moderately good soil, the trees average

20 feet in height. There is also some quantity of younger larch, mixed with Scotch fir and a little spruce, planted about eight years ago, which is doing pretty well. The soil is evidently best adapted for the growth of larch.

A few deodars have been planted in the rides for ornamental purposes. They are growing very slowly in the lower and damper portions of the wood, but a little better on the uplands.

A good deal of damage is, Mr. Gulliver informed me, done by rabbits to the young trees, and last year a disastrous fire occurred, which swept through and destroyed some thirty acres of plantation before it could be stopped, although the soldiers from the neighbouring barracks were turned out to aid in extinguishing it. The damage done is so apparent, that I think it would convince any of those who doubt the necessity of putting a stop to forest fires in India, and maintain that they do no harm. Luckily, the trees in this portion of the wood were of no great value, so that the loss will be comparatively trifling.

The revenue of the forest for 1870–71 was 368*l.*, and expenditure 288*l.*

Most of the revenue is derived from the sale of oak bark, which is small but of good quality. Last year 23½ tons were sold, which is nearly 10 tons less than the usual yield.

Scotch fir thinnings realize from 6*d* to 8*d.* per tree on the spot, and larch a little more. On the whole this wood does not repay a visit, and I merely inspected it as I was in the vicinity seeing Portsmouth Dockyard.

The Dean Forest.

Extent and Divisions.—This forest is situated in the county of Gloucester, to the north and west of the River Severn. The total acreage of the forest within the perambulation is 22,500 acres, but of this extent there are 3,300 acres in which the Crown has only mineral rights, leaving 19,200 acres in which the Crown has the right to the soil.

The forest is under the charge of Sir James Campbell, as deputy surveyor, with one assistant. Sir James has also charge of the High Meadow Woods, which adjoin.

His residence at Whitemead Park, near Coleford, is very conveniently situated as regards the forest, which extends on either side. There were until lately two assistants to

the deputy surveyor, but most of the available area having been planted up, and the trees, as a rule, being past harm's way, one has been dispensed with, and the emoluments of the one retained slightly increased.

Nurseries and Plantations.—No nurseries are now kept up, owing to the cessation of planting for the reasons given above. Any plants required for filling up vacancies, &c. are purchased from the nurserymen, who have also supplied the coniferous seedlings for the small plantations made during the past two years, to be noticed hereafter.

I visited 12 plantations of various ages varying from those of 1844 to the present season, viz., Bream's Eves, Milk Wall, and Hangerbury, of 1844; Bourt's and Middle Ridge, of 1847; Churchill, 1856; Moseley Green, 1858; St. John's and Cinderford, of 1859; Little Kensley, 1869–70; Bream New Enclosures, 1871; and Bradley Hill, 1871–72.

I had thus an opportunity of judging of the growth of the young trees over a period of nearly 30 years.

The plantations are mainly oak, with fir and larch nurses, which have been removed entirely in those of the earlier dates. Here and there I observed a little chestnut and walnut, but nowhere in any quantity.

The soil cannot be considered generally favourable for the growth of oak or any hard wood tree. In the hollows it is, as a rule, clay, and only here and there do we find a bed of good loam. The country is very undulating, and on all the upper portions the rock crops out. On the outer edge it is generally limestone, with sandstone and conglomerate in the interior circles.

The larch does well, and the Scotch fir exhibits a very fine and heathy growth; in fact, in some places where there is scarcely any soil over the rock, it is marvellous to see fine straight trees of a most robust appearance.

The Scotch fir is not, however, of much use here in a financial point of view, as there exists a strong prejudice against it for pit-props, for which there is a great demand. I cannot help thinking that this prejudice must be, to a great extent, unfounded or based on insufficient data, for it is the tree mainly used for this purpose in the extensive mines in Lanark and Ayrshire, in Scotland, and I have never heard there of complaints as to its brittleness, which is the reason adduced for its not being used here. The nature of the soil, or other causes, may, however, affect the timber injuriously.

Of the younger plantations, Churchill, which is the first formed by the present deputy surveyor in 1856, is doing

particularly well. Little Kensley (1869–70), extending over 137 acres, newly drained and planted with oak and beech, with nurses of spruce fir, promises well; and Bradley Hill, which is just finished, in fact, some of the nurses have still to be put in, and covers about 80 acres, afforded me an opportunity of observing the healthy state of the recently transplanted trees, and the few casualties which had taken place.

The deputy surveyor does not plant out the nurses first and hardwoods afterwards, as is done in the New Forest, finding it better to put both out together, the situations not being so exposed as in Hampshire.

He digs pits for all descriptions, and considers it advantageous to do so, and that, although the first cost is, of course, greatly beyond that of planting a similar area with the nurses slitted or notched in, it is amply repaid by the immunity from loss, and consequent necessity of replanting, and by the faster and straighter growth of the trees year by year. I note this particularly, as it is the only instance in which I have found the coniferous trees pitted in this country, and because in my report on the Scotch Forests I have expressed an opinion that we rather over-do the pitting in India, that is, that the results are not commensurate with the great extra expense. Sir James Campbell's experience tends the other way.

For oak, he makes use of pits from 10 to 12 inches deep and 18 to 20 inches square, and for the fir and larch nurses, pits of about the same depth and one foot square. These he has dug at not more than 1*s.* per hundred, which appears very moderate.

The later plantations of oak with larch nurses are formed in alternate rows of these trees, four feet apart, and the average cost is about 8*l.* per acre, although, in some cases, it is much more or less, according to the nature of the soil, circumstances under which it is planted, &c., &c. This rate contrasts very favourably with that existing in other localities.

Sir James Campbell has experimented very successfully in planting out young trees, principally oak, in the common (uninclosed) lands, and, in fact, on what might be termed village greens. No objections have been raised to this, and the villagers are now reaping the advantages in the shape of improved pasture for their cattle and sheep, and shelter from the cold in winter and excessive heat of the sun in summer, whilst the appearance of the village or hamlet is greatly improved by the presence of the grove, or what we should call in Madras *tope*, of trees.

Near Cinderford a considerable tract has been planted out in this way, and a careful record kept of the growth compared with that of seedlings of the same year left untransplanted in and around the nursery. The smallest trees of the former now surpass, both in height and girth at six feet from the ground, the largest of the latter.

Fires are unfortunately not uncommon in the plantations, and I saw several tracts in which the trees had been destroyed by them. A spark from a miner's pipe or gipsy's fire suffices in summer to set the grass on fire, and, once lit, it is almost impossible to extinguish. A greater subdivision of the plantations into small blocks by means of ridges, which act as "fire traces," would appear advisable.

Woods.—I visited 20 different woods or inclosures, including those of the High Meadow estate, ranging from the scattered trees of 1707 and 1782, to the fine and regularly trained woods of the beginning of the present century. I would particularize those of Astonbridge (1816), Sallow Vallets (1812), Buckholt (1816), Perch (1816), Burnhill (1809), Nag's Head (1814), situated on a gentle slope with a southerly exposure, and Staple Edge (1814), and Cockshot (1815), on the other side of the forest, as the finest I saw, and containing a large capital of finely grown oak timber.

There has been little or no felling of mature trees for some years past, and I believe the Admiralty has now ceased to indent on the forest for supplies.

The blight has done much damage recently, and seems to increase year by year, whole tracts being left leafless during the summer by its action. At the time I visited the forest (in February) there was, of course, none; but Sir James explained to me that it appeared along with the young leaves or leaf buds, in the shape of a canker or unhealthy spot; that his attention was invariably attracted to it by the myriads of small flies which hovered about the affected parts; that shortly a sort of caterpillar developed itself, which preys upon the leaves and young shoots until it arrives at the moth stage, when it departs, leaving the tree leafless and sickly.

The matter appears to demand careful attention, and an accurate study of the symptoms, in order to arrive at some idea of the cause, whether atmospheric or the result of some particular chemical action of the soil, which is so rich in mineral deposits. The damage done is very great, and financially must represent a very large sum per annum.

Sir James sells the thinnings at 30*s.* per chord all round, and for small wood, such as tops, loppings, branches, and underwood, he realizes an average price of 15*s.* per chord of 128 cubic feet. Most of this small wood is taken for the manufacture of pyroligneous acid and naphtha, after which it is sold as charcoal.

Very little charcoal is now manufactured by the old method; that received from the naphtha works is not so good as what is manufactured specially as charcoal, as all the best qualities of the wood are extracted, still it is found cheaper to use a greater quantity, as the manufacturers of the naphtha can afford to lower the price for what would otherwise be useless and unprofitable to them.

I have omitted to mention that there are some remarkably fine beech trees in this forest, and that the soil and climate would appear well adapted for an experimental plantation, on the German system, of mixed oak and beech.

The revenue of the forest for 1870–71 was 10,838*l.*, and the expenditure 7,878*l.*

Fencing.—Turf banks may be said to constitute the fence of the forest, and Sir James Campbell retains an improved description in the formation of inclosures.

His turf banks are 3½ feet high, and faced with stone up to 3 feet from the ground, with a wire running along stakes fixed in the bank, making the whole nearly 4½ feet high, which is found necessary to exclude ponies and cattle, which manage to get through or over any other description of fence. Quick is planted along the inner side, and trained along the top, which, when fully grown, renders the inclosure quite impervious. This method of inclosing is rather expensive, costing nearly 2*s.* per running yard, and I must say I prefer Mr. Cumberbatch's hoop-iron fence, although it might not suit Gloucestershire.

Short History of the Dean Forest.

The history of the formation and management of this forest so closely resembles that of the New Forest, of which I have already given a description at some length, that I shall only state briefly the leading features in connexion with it.

The first legislation with regard to it appears to have been in the reign of Charles the Second, when an Act was passed, authorising the throwing out of pieces not less than

500 acres in extent, in which the trees were so far grown up as to be free from injury by cattle, and the inclosing and planting an equal quantity of open forest. By another Act in the reign of George the Third (already quoted with reference to the New Forest), further powers as to inclosing and planting were granted as in the New Forest, and further legislation as to the rights of the Crown in the minerals and substrata, and those of the free miners and owners of what are called "gales," has taken place during the present reign. It must be borne in mind that the mining interest is predominant in the Dean Forest, and that the mineral rights form far the most valuable portion of the property. This renders it difficult, if not impossible, to exclude persons from any part of the forest, which is intersected with paths, roads, and even tramways and light railways, leading to the various mines, which are often situated in the middle of an inclosure or plantation. Applications for the sinking of new shafts are referred to the deputy surveyor as regards the value of the timber, its removal, &c.; but, considering the value of the Crown royalty on each mine sunk, it would be inexpedient, and probably fruitless, were he to raise objections to any piece of forest or plantation being given up, unless peculiar circumstances, which might have escaped the notice of the Government mining engineer, justified his doing so.

The number of free miners registered is 1,280, of whom some have since died or left the country, and the number of existing grants of "gales," or rights to minerals, is stated by the return of 1863 to be 500, but that number has probably been greatly exceeded since that date, as numerous mines for coal and iron have been and are being constantly sunk.

The prescriptive or communal rights in the forest as to cutting of turf, grazing, &c., are nowhere clearly defined as in the register of those entitled to rights of common. It is curious that the Act of Parliament which authorised the enclosure and planting of certain areas does not direct any inquiry as to the nature of the common rights, nor as to estates or persons entitled to the privilege, in a similar manner as was prescribed for the New Forest. This will probably have to be done sooner or later, although, at present, I am informed that everything is going on smoothly, no encroachments being made by the commoners, and the Crown officers not being over strict as to whether those who exercise rights of pasturage or turbary are legally entitled to them or not.

Under existing regulations, not more than 11,000 acres can be enclosed at any one time for the growth of timber, and Sir James Campbell estimates the area now actually under timber at about 14,500 acres.

High Meadow Woods.

This estate is situated in the counties of Gloucester, Monmouth, and Hereford, and extends over 3,400 acres, all either old woods or plantations, and 60 or 80 acres let to tenants either as arable or meadow lands. The property was purchased under the authority of an Act of George the Third, which recites the advantages to be gained by the purchase in the quantity of thriving oak growing on the estate, its contiguity to the Forest of Dean, facilities for the transport of timber by water, &c. Some of the woods are particularly fine Nockalls, Marians, Mailest, and the view from Symond's Rock of the wooded banks of the Wye is most gratifying to the forester, as well as to the lover of the picturesque.

The estate, as already stated, is under the charge of the deputy surveyor of the Dean Forest, and I do not consider it necessary to enter into further details.

The property is, of course, freehold of the Crown, and there are no common or prescriptive rights.

The revenue derived for 1870–71, was 5,176*l.*, and the expenditure only amounted to 1,827*l.*, leaving the handsome profit of upwards of 3,000*l.* on as many acres.

ABSTRACT STATEMENT of the Total Acreage, Extent actually under Wood, Description of Timber, and Nature of the Rights of the Crown in each of the Royal Forests and Woodlands (compiled from a Return to the House of Commons in 1863).

Name of Forest or Woodland.	Acreage (measured or estimated).	Acreage under Wood.	Description of Trees.	Nature of Crown Rights.	Remarks.
	Acres.	Acres.			
New Forest	65,000	22,319	Oak and beech, with outside belts and clumps of Scotch fir and larch in the older plantations, and oak, Scotch fir, and larch in the younger plantations.	2,000 acres are freehold, of which 668 acres are let to tenants. In 63,000 acres the Crown has the right to the soil and timber, and of inclosing parts of such land not exceeding 16,000 acres at any one time, such inclosures to be thrown open when the trees are past danger of damage by cattle, and a like area inclosed for planting purposes.	In addition to the 65,000 acres there are 26,000 acres in the Forest the property of private individuals, with regard to which the Crown rights appear uncertain, if indeed any exist. The extent under timber has been considerably increased since 1863, and now amounts to at least 24,500 acres. There is a complete register of commoners and the rights to which they are entitled.

Name of Forest or Woodland.	Acreage (measured or estimated).	Acreage under	Description of Trees.	Nature of Crown Rights.	Remarks.
	Acres.	Acres.			
Dean Forest -	22,870	14,754	Oak, beech, and fir, with a little chestnut and walnut.	592 acres are freehold, of which some 25 acres are let to tenants, and a considerable portion attached to Whitemead Park and the woodmen's cottages. The Crown has the right to the soil and timber in 19,000 acres, with power to inclose not exceeding 11,000 acres at any one time, such inclosures to be thrown open as in New Forest, and like areas enclosed for planting. The Crown's rights as to minerals and sub-strata are regulated by the Acts 1 & 2 Vict. and 24 & 25 Vict.	There is a complete register of free miners and owners of "Gales" in the Forest, but none of the commoners entitled to exercise forestral rights, nor has there been any inquiry into or definition of such rights and who are privileged to exercise them.
			3,278 acres are the property of private persons, and the Crown are not entitled to the timber nor to inclose and plant the land, but possess certain forestal rights.		

Abstract Statement of the Total Acreage, &c. in each of the Royal Forests and Woodlands—*continued.*

Name of Forest or Woodland.	Acreage (measured or estimated).	Acreage under Wood.	Description of Trees.	Nature of Crown Rights.	Remarks.
	Acres.	Acres.			
High Meadow -	3,359	3,359	Oak and fir - -	Freehold - - -	Purchased under the provisions of Act 57 Geo. 3., which recites the expediency of the purchase owing to the quantity of thriving oak, forest, &c. In addition to the 3,359 acres there are 60 to 80 acres belonging to the Crown let to tenants in various small holdings.
Alice Holt - -	2,039	2,039	Oak, with 100 acres larch and ash.	Freehold - - -	Planted under the provisions of Act 52 Geo. 3. Planting commenced in 1812 and finished in 1836.
Woolmer - -	2,808	1,235	Scotch fir, larch, and pine, with a little oak.	Freehold - - -	Planted under the provisions of Act 52 Geo. 3 as above. Planting commenced in 1813 and finished in 1836. 1,572 acres are unfit for the growth of timber.
Bere - -	1,456	1,456	Oak - - -	Freehold - - -	Planted under the provisions of Act 50 Geo. 3., passed in 1810. Planting commenced about 1812.
Parkhurst - -	1,160	1,160	Oak, larch, beech, chestnut, Scotch fir, and stone pine.	Freehold - - -	Planting commenced about 1814 under the provisions of Act 52 Geo. 3.

Name of Forest or Woodland.	Acreage (measured or estimated).	Acreage under Wood.	Description of Trees.	Nature of Crown Rights.	Remarks.
	Acres.	Acres.			
Delamere - -	4,022	2,622	Oak, larch, and Scotch fir	Freehold - - -	All planted since 1817 under the directions of Act 52 Geo. 3. 1,400 acres have been let as farms.
Salcey - -	1,277	1,277	Oak - - -	Freehold - - -	Planted between 1832 and 1846 under the authority of Act 6 Geo. 4.
Hazleborough -	489	489	Oak - - -	Freehold - - -	Planted between 1830 and 1835 under the authority of Act 5 Geo. 4.
Chapwell - -	896	896	Chiefly larch, some Scotch pine, alder, and birch.	Freehold - - -	Planted between 1853 and 1859 under the authority of the Lords of the Treasury and the Commissioners of Woods, &c.
Epping - -	7,000	—	- - - -	The Crown is not the owner of any woods or plantations in Epping Forest (so called), but is entitled to certain forestal rights. Those rights, over 4,000 acres have been sold.	This forest should really not appear as one of the Royal forests and woodlands, but I have exhibited it as it appears in the statement from which this is compiled.
Total acreage -	112,376	51,606			

THE SCOTCH FORESTS OF THE EARLS OF SEAFIELD AND MANSFIELD, THE DUKE OF ATHOLE.

Messrs. Lawson and Sons' Nurseries near Edinburgh.

These nurseries, mentioned by Dr. Brandis in his Memorandum for the Guidance of Forest Officers on leave, are situated between Edinburgh and Granton, and extend over 270 acres. Mr. Lawson gave me every facility for making myself acquainted with the system pursued; and my thanks are due to Messrs. Syme and Johnston, his assistants, for the trouble they took to show me everything worthy of note, and the time which they devoted to me. My visits extended over a week, which I consider to have been most usefully employed, although how far the system of the treatment of seedlings in this country can be applied to India remains to be proved by experiment.

The chief crop in the nurseries is composed of *coniferæ* of all varieties, of which Mr. Johnston informed me there were not less than thirty millions at the time of my visit.

Besides the Scotch fir, spruce, and larch, the *Pinus pinaster*, *Austriaca*, and *Laricio* appear to be most in demand.

The first is largely used for planting on light sandy soils near the sea. *Pinus austriaca* is in great demand for Ireland, and the last is now being tried in most of the pine plantations of the United Kingdom, having one great advantage, viz., that game, particularly rabbits, do not like it, and will not attack it, unless during very severe weather, and in the absence of all other herbage.

Before sowing or forming the nursery beds the land is trenched to a depth of 14 inches, and a crop of potatoes taken off it to clean it. In the following spring the seed beds are laid out, and the upper soil carefully prepared to suit the nature of the tree which is to be sown.

Most of the *coniferæ* prefer a light dry soil with a considerable proportion of sand, and this has the advantage that the seedlings are easily picked out and shaken free from each other on transplanting.

In the case of Scotch fir and larch, the seed is sown in May and June, and left in the seed beds for two seasons. The seedlings are then planted out in lines 14 inches apart,

and three inches between each plant; they are left thus for one or sometimes two years, and then planted out for good.

Mr. Johnston appeared to think it better to sow as early in May as possible, or even in April, and transplant after one year, or even in the same autumn, directly the leaf-bud is hard; but there is risk of frost in April, and even early in May, which would of course destroy any seedlings coming up then.

The spruce requires to be left two full years in the seed beds, as its growth while young is slower than that of larch or Scotch fir.

The *P. pinaster, Austriaca,* and *Laricio,* are sown in May or June, and transplanted in the autumn of the same year into rows six inches apart, the plants close together. Thence they are re-transplanted in the following autumn, into rows 14 inches apart, as is done with the Scotch fir, &c., where they are left one and even two years before being planted out.

In this and similar cases, the first removal is termed "bedding," and the second, when each seedling is put out separately in the row, "transplanting." Thus, we hear of "one year seedlings, one year bedded, and two years trans-"planted," which means that the young tree was one year in the seed bed, one year in the close rows, and two years in the open rows before being planted out.

Little or no care is taken of the tap-roots; in fact, it is considered an object to shorten them, and encourage the formation of lateral and fibrous roots instead. In cases where the seedlings are left two consecutive years without transplanting, which occurs if the growth is slow or the demand slack, the roots are cut over with the spade about eight or ten inches below the surface to prevent the growth of a long tap-root.

In fact, the attention of the nurseryman is mainly devoted to checking any excessive vertical growth either of stem or root, and to encouraging the formation of fine radical fibres. This is exactly the opposite to what has been impressed on us in Madras, where, both with regard to the *Eucalypti* and *Acaciæ* on the hills, and the *P. pinaster* (*maritima*), with which so many experiments were made, our main endeavour and difficulty has been to preserve the tap-root intact.

There may be reasons for this in India, but I am not aware that the subject has received that attention in the Madras Presidency which it appears to deserve. The saving of trouble, time, and expense, by not having to be careful about the tap-root, is enormous, although, of course, we could

never with impunity treat seedlings in India in the rough manner in which they are treated in a temperate climate. Here they are lifted, tied in bundles, tossed into a cart, and transported to Ireland, or even across the Atlantic to Canada (where I was astonished to hear Messrs. Lawson have contracts for planting), in a manner marvellous to an Indian forester accustomed to deal with each individual seedling in a careful manner, and to see even the slightest rough handling result in the loss of the young tree. I cannot help thinking that our nursery management admits of much improvement; hence the cause of the extreme delicacy of our young trees.

I saw all the operation of lifting and packing the young trees, besides transplanting, &c.

The crop of hard wood in the nurseries is not extensive, but includes all the principal species most in demand.

I had almost forgotten to note that there are several beds of deodar doing well, and *Cupressus torulosa* flourishes here as well as on the Neilgherry and Pulney Hills.

The Earl of Seafield's Woods and Plantations in Strathspey.

I spent a week in Strathspey, and obtained much valuable information as to the growth of *coniferæ* from Mr. Grant Thomson, Lord Seafield's wood manager, to whom I am greatly indebted for his courtesy and the anxiety he evinced to show me all he could in the time at my disposal.

The tract of country, chiefly moorland, under his charge extends to at least 60,000 acres, of which 30,000 to 40,000, or a little more than half, is now actually under timber. Mr. Thomson's wish is gradually to plant up the whole, so that, in the course of time, 1,000 acres could be felled annually, and a like extent planted out, and I think the object cannot be too steadily kept in view, as it could not fail to bring in a large revenue, without impoverishing the forests, or, so to speak, trenching on the capital in timber.

Mr. Grant Thomson considers that the sale of thinnings, grazing dues, &c., should suffice not only to pay the establishments employed (including his own salary), and the working expenditure for the nursery planting, fencing, &c., but also the rental of the land, which of course is very low, leaving all the proceeds from actual clearing, or what is known as a "clean cut," as clear profit.

The woodlands are divided into three districts, known as Grantown, Abernethy, and Duthil, each under the immediate charge of a forester, who is responsible to Mr. Thomson for all the work of his district.

Abernethy is by far the largest district, and Mr. Sampson, the forester there, is highly spoken of by Mr. Thomson, and appears particularly intelligent and zealous in the performance of his duties, which include the charge of the nurseries, floating timber down the Nethy, and the management of extensive planting and thinning operations.

The nurseries cover a space of about 13 acres, of which from 10 to 11 acres are at present under crop, principally Scotch fir.

The nursery management differs in no material respect from that in force at Messrs. Lawson & Co., excepting that here, as a rule, the young trees are received as purchased from market nurseries, as one or two years seedlings, or one year seedlings and one year bedded. They are then kept a year, or sometimes two, in the Abernethy nursery previous to planting out for good.

It is doubtful whether the nursery would not have been better situated near Mr. Thomson's house at Grantown, which is more central, and not so exposed, but the healthy condition of the young trees, and neatness of the Abernethy nursery, speak volumes for Mr. Sampson's care and the system in force.

I saw three lines of Scotch firs lifted and tied in bundles for planting out.

This is done very expeditiously by two men, with the "grape," or five-pronged fork, digging out the young trees in the lines, which are then lifted in bunches by the women, the loose earth shaken off, and the plants tied in bundles of convenient size. The average number of young trees in each row is previously ascertained, and now and then a row is counted as dug up, as a check; but Mr. Thomson informed me that, after a little experience, a workman or woman could tell by touch, to within one or two, the number in a bundle or bunch.

As a rule, the young trees are lifted one day, conveyed to the ground early the next, and planted out before that evening, so as to obviate, as much as possible, any risk of loss, such as has been known to occur, when a number of plants are *sheughed* (*i.e.*, stored, with a coating of earth round their roots, in a sheltered corner) on the ground ready for planting, and operations suspended by snow so long that almost all were destroyed by rot.

I saw a couple of beds in the nursery which had been sown by the candidates selected for the Indian Forest Department, who were here last year. The seedlings were coming up well, but a little too thickly, which is generally the case with amateur sowing.

The nursery contains specimens of *Wellingtonia gigantea, Cupressus torulosa, Araucaria imbricata,* &c., and is conveniently situated close to the forester's house.

Plantations.—I inspected nine plantations, varying in extent from 300 to 1,200 acres, and had thus the opportunity of seeing the young trees at all ages and under the most varied circumstances as to soil, altitude, and exposure.

The bulk of the plantations consist of Scotch fir, with a comparatively small number of spruce and larch. On an average, particularly in the portions planted out since Mr. Thomson has been in charge, the proportions are 2,000 Scotch fir to 500 larch to the imperial acre, but in some exposed situations there may be 3,000 plants to the acre.

I do not include under this head any trees over 15 years of age, which I shall notice briefly under the head of woods.

The oldest plantations which I visited were Tulquhonie, in the Dutch district, extending over 600 or 700 acres, and Tulchan (400 to 500 acres), in the Abernethy district, of which about 100 acres have been planted 11 or 12 years ago. In both, particularly the former, the Scotch firs are very healthy and regular on the ground, with an average height, in favourable situations, of from 10 to 12 feet, and in the most unfavourable spots reaching to six or eight feet. The spruce is not frequent, and its growth contrasts unfavourably with the fir, whilst the larch, in some very sheltered spots, surpasses it in growth, but in no case presents so healthy and robust an appearance.

In the Duthil Hill Plantation, extending over 600 or 700 acres, where the plants average six years since first put out, their average height is from five to six feet.

In Deshar Plantation, 1,100 acres, enclosed seven years ago, and planted gradually since, the young Scotch firs average from four to five feet in favourable localities, with fine shoots for this year of 16 to 22 inches in length, but there is a marked difference in the exposed situations, where the young trees have not "come away" well, and do not average two feet high.

The larch in this plantation is not doing at all well. The same remarks apply to the Sluemore Plantation, in the Abernethy district, 500 to 600 acres, planted about five years ago, where the average height is three feet, and the plants are very healthy, particularly the fir.

In the Revack Plantation, of 700 acres, the young trees planted from three to four years ago are doing well, with the notable exception of some 10 acres on the westerly side, which was planted, against Mr. Thomson's judgment, the

year after the ground had been cleared of a former crop of trees, which had proved an entire failure, scarcely a single tree being left of those planted out. Mr. Thomson has found this the case in other instances, and considers that it may be laid down as an axiom that, in Strathspey at least, the land should be left barren and untouched, after it is cleared of trees, until the natural herbage, whether heather, grass, or moss, which existed before the trees grew, recovers; and that if planted before this takes place failure will result. No definite time can be laid down for this operation of nature, but the fact is fully borne out by observations of the natural or self-sown tracts to be noticed further on in this Report.

We may find this apply in India, though it certainly does not in replacing the natural wood by the Australian *Eucalypti* and *Acaciæ* on the hills, and it will be noticed in remarks on Lord Mansfield's woods (page 113), that Mr. M'Corquodale, with the experience of 30 years, does not agree with Mr. Thomson, although he admits that young trees, planted in the usual method, will not do, owing to the attacks of the beetle.

The Bengulapin Plantation, 1,000 to 1,200 acres, in Duthil district, is particularly noteworthy, from the fact that here we find the Scotch fir planted and doing well up to a height of 2,000 feet above the level of the sea. This large extent of moorland has been gradually planted, the oldest plants having been out six and the youngest only two years. A belt of old Scotch fir has been judiciously left as a screen to the young trees standing on the westerly side, whence come the prevailing winds. Those at the summit were planted out last, as Mr. Thomson finds from experience that they will only grow in such situations, where they are exposed to wind from all sides, if the lower portions of the hill are first planted, and a certain amount of shelter thus derived.

This fact should not be lost sight of in our hill plantations in India, where we suffer so much damage from the high winds. The young trees on the summit are not growing fast, but are healthy and strong. I did not observe a single casualty, and, when once firmly established, have no doubt of their "coming away" and eventually clothing the mountain even to its top. I attach much importance to this, as I have often heard it questioned, particularly in this country, whether trees could be grown to any advantage at such an altitude, and exposed to strong winds and storms.

On the easterly side of this hill there are a good proportion of larches doing very well, the situation having been

judiciously chosen. It may here be noticed that Mr. Thomson has entirely given up the rigid system so much in vogue at one time, and with some wood managers, of planting alternately a Scotch fir, a larch, a spruce, or hard wood at certain distances, the interval of space being filled up with "nurses" of fir, spruce, or larch, in equal quantities, without any reference to the nature of the soil, expense, &c., and has adopted the much more sensible plan of putting down the tree which is most likely to do best, which in his opinion, fully borne out by appearances, is the Scotch fir on heather land and all exposed situations, and the larch on grass land and in sheltered spots, where the spruce will also do fairly.

I have now only to allude to the Advie Plantation, Abernethy district, of about 300 acres, in which the trees were planted out last autumn and this spring. They were then, as is the rule throughout, one year seedlings, one year bedded, and one year transplanted; and those put out in spring do not now average more than 6 or 8 inches from the ground, whilst those of last autumn, having made short shoots this year, may be 8 to 10 inches high. Still, they are all healthy, and Mr. Thomson is quite satisfied if they establish themselves during the first twelve months. It struck me at first that they might be put out taller, but Mr. Thomson informed me that this had been tried, and the result was greater difficulty and risk in moving from the rows in nursery, and a large per-centage of loss by their getting wind-shaken when planted out on the hill side, the extra year in the nursery without re-transplanting representing an upward growth of 6 to 8 inches.

It cannot be too clearly borne in mind that the great aim in the nurseries in this country is to grow root fibre, and check the upward growth of the young tree, which is effected, as already detailed in the description of Messrs. Lawson's Nurseries, by frequently transplanting, and cutting over the roots. Whether this might not, in some cases, be advantageously introduced into our Indian practice, I am not competent to say, but think it merits attention and experiment.

All the trees are planted out by what is termed "slitting," as clearly explained in "Brown's Forester," "Grigor's Arboriculture," &c., viz., two cuts with the spade at right angles, thus A|— or A|-- , the plant being inserted at the point A, where both meet, and the earth then firmly pressed down with the heel. Before inserting the spade the man

removes a small sod of the coarse heather or turf, which might otherwise choke the young tree. The distances are not measured, or even roughly pegged out, but there is wonderful uniformity, the men being drawn up in a row before starting, and each taking his own line. One woman is told off to every two men, to supply plants, and she in turn is supplied by other women, who bring the plants from the place where they are stored. In this manner two men and a woman can plant at least an acre *per diem*, and the cost, including leading of young plants from the nursery, does not exceed 3*s.* 6*d.* per thousand, or say, 10*s.* per acre of 3,000 trees.

Self-sown Fir and Larch.

The natural reproduction of the Scotch fir and larch is seen to great advantage in Strathspey.

Wherever the natural herbage or vegetation has sprung up in places formerly covered with coniferous trees, and in the vicinity, the seeds appear to germinate, and a crop appears, sometimes thick and even enough to render replanting unnecessary.

Mr. Thomson's plan is to enclose (by wire fences) tracts where he sees this natural reproduction commencing, and in some cases, where the surface is mossy or covered with rank coarse grass, to assist nature by removing sods every few paces, thus giving the seeds and seedlings a chance of coming on. This promises to be very successful. We found several young trees coming up in every space thus bared. For the same reason, as well as for shelter, as already explained under "Plantations," clumps of old trees are left on the ground, the cones of which disseminate the seed.

I visited several tracts where the process of natural reproduction had taken place, and though the growth is not rapid at first, and the tracts naturally present a very uneven appearance compared with those artificially planted, the young trees after the first few years appear to "come away" with fine straight and strong shoots, some of which we measured, and found that for this year the growth had been two and even two and a quarter feet.

In a large tract of self-sown forest in the Grantown district, inclosed six years ago, the Scotch firs average certainly 6 feet high, whilst individual trees run up to 10 feet. The growth of the larch is not quite so good, but I saw some fair specimens.

It is particularly noteworthy that wherever the heather presents itself as the natural herbage, the Scotch fir is the tree which springs up, whilst on grass land the larch, and

even the spruce, already stated to be comparatively rare in this part, are more frequent. It is from observing this natural result that Mr. Thomson arrives at his conclusions as to where to plant the several species, as noted under the head of "Plantations," and the results fully justify his doing so.

In the Cranish Inclosure, Duthil district, there is a fine growth of natural Scotch fir and spruce, with a little larch, and at the foot of Bengulapin there is a considerable extent of Scotch fir and birch, both self-sown.

Cattle, goats, sheep, &c. are, of course, rigidly excluded from the inclosures for the first ten years, and Mr. Thomson is fortunately not much troubled with rabbits or fallow deer.

The whole process is very similar to what we are doing, or trying to do, in Madras, under the name of "railway fuel reserves," but in this country there is not much danger from fires, though they have occurred, and Mr. Thomson appears to have no difficulty as to cattle trespass, rights of way, &c. He impounds any cattle found within the inclosures, and experiences no trouble nor delay in getting human trespassers adequately punished. Such offences are consequently very rare.

Woods.—These are of all ages, from the scattered park trees, near Castle Grant (Lord Seafield's residence), and some old veterans, probably 150 years old, in the Abernethy district, to the young woods of 15 years old.

There is not, however, so far as I could judge from so short a stay, much extent of mature wood ready for or requiring a clean cut, though there is an ample supply of thinnings of all ages.

Birch is the only hard wood tree which occurs in any quantity, and it is little felled at present.

In thinning the coniferous trees, no rigid rule is laid down. They are generally gone over first when from 15 to 17 years old, and any sickly trees, or those which are affecting injuriously the growth of others, thinned out; but there is little or no sale for such first thinnings, as no hop poles are required, as in the south of England.

After the age just mentioned, the woods are gone over periodically, and a certain number of trees marked for thinning, and sold standing, in convenient lots, by tender or private bargain.

When none but mature trees are left standing (there are rarely 200 to the acre, and the wood is from 60 to 80 years old), there is what is termed a "clean cut," the trees being sold standing as above, and the purchaser bound to

remove them within certain dates, paying in advance for each lot before removal. The ground is then allowed to lie fallow until the natural herbage returns, as already described.

In selling thinnings, the felling, and sometimes the pruning are done by the proprietor, to prevent damage to the standing trees. In a clean cut the felling is almost invariably left to the purchaser. All felling, except in the case of saplings, is done with the cross-cut saw, which saves great waste in timber, and the use of which we should lose no time in introducing and making universal in the Government forests of India.

As each tree is felled, it is the duty of the forester to stamp the stump with a hammer, bearing the proprietor's initials, which he keeps in his possession, and can thus see if any unmarked tree has been felled, and the wood manager can, in like manner, check the felling and number of trees removed. In some cases the butt of the tree removed is also stamped.

This system, with some modifications, might, I think, be adopted with advantage in India, and the year might be added to the stamp.

The timber trees (coniferous) in Strathspey are divided for the purposes of sale into three sorts, viz., timber, spars, and props.

Under the former are classed all trees eight inches and more in diameter at twelve feet from the base.

Spars include all which are under eight inches and over five inches at twelve feet from the base.

Props are those below five inches at twelve and not less than three at six feet from the base. Anything below this is not classed.

Mr. Thomson gives the price of Scotch fir in Strathspey at 6*d.* per cubic foot all round, and larch at 1*s.* per cubic foot, but the demand for the latter is greater than the supply. At these rates all expenses of felling, carting, &c. are borne by the purchaser.

In a recent sale of thinnings, in Tomienourd Wood, Mr. Thomson paid for felling and pruning (on contract) 5*s.* 6*d.* per hundred trees, and received for,—

	s.	*d.*	
Scotch fir, timbers - - -	3	6	each.
,, spars - - -	1	3	,,
,, props - - -	0	8	,,
Larch, timbers - - -	5	0	,,
,, spars - - -	3	6	,,
,, props - - -	1	0	,,

These rates, though not high, are very remunerative. I saw the thinning going on in the above wood and elsewhere. The trees selected were marked by a blaze on each side, on one of which the proprietor's initials were stamped. There is little or no pruning, and Mr. Thomson does not remove the lower (dead) branches from the trees. He is particularly fortunate as to game, there being very few rabbits, and his greatest enemies are the squirrels, which do a good deal of damage in severe winters, by eating the bark right round a young tree or branch. Even these, however, he is allowed to have shot, and pay a reward to the keepers of so much per tail.

Roads and Paths.—In all the new plantations Mr. Thomson is laying off paths about a yard wide, fit for dragging, and which may be widened and made into cart roads as required. There is no particular gradient maintained, and in many places they would be found too steep for our dragging or carting purposes in India. The paths generally run in parallel lines round and up the hill side, ascending to the very top even of Bengūlapin (*i.e.* 2,000 feet above the sea), and are intersected by cross paths.

By the adoption of this system much trouble will eventually be saved, as we know, by experience, the difficulty of making paths or roads through a thick forest or plantation in which it is impossible to see more than a few yards in advance, and there is a double object, viz., that the paths act as fire traces, and can be utilized in case of fire for forming a line of men, and preventing its extending to the rest of the plantation or wood.

The paths are cheaply made by contract at $1\frac{1}{2}d.$ per running yard.

Mr. Thomson is constructing rough cart roads on the same principle, and improving those which already existed. For those now being laid out he is paying 6*d.* per running yard, four yards in width, and the work is very well worth the money. We could not do the like in Madras for four times the amount; and, when it is remembered that a day's wages for a man is 2*s.* 2*d.*, it appears marvellously cheap. The line is marked out by the forester, under Mr. Thomson's superintendence.

Fencing.—All the new fencing is wire, which is found far the best and cheapest in the long run. Thousands of acres have been thus enclosed, and I was fortunate enough to see the work in progress, and make myself practically acquainted with the method adopted.

There are six wires, that at the top being thickest, and known as No. 4, the other five wires being No. 6. The wire

costs $3\frac{1}{2}d.$ per running yard. The posts are supplied on contract, and delivered along the inclosure to be fenced at $3d.$ each, which Mr. Thomson finds cheaper than working them up and carting them by means of his own establishment. They are, as a rule, prepared from wood purchased from the estate, and sawn in the proprietor's saw mills, which are leased to wood merchants.

The straining posts, which are, as a rule, about 100 yards apart, the distance varying according to curves and dips, are $7\frac{1}{2}$ feet long by 7 inches square. They are sunk 3 ft. 8 in., or half their length, in the ground.

The intermediate posts ($5\frac{1}{4}$ ft. × 5 in. × $2\frac{1}{2}$ in.) are 6 feet apart, and sunk 1 ft. 8 in. in the ground. As a rule, the tops of the posts are sloped off, for appearance sake, and to allow of the rain running off.

When the posts which have been laid along the line by the contractor are firmly fixed in the holes (stays or supports being made use of when required in uneven ground), the wires are run in through staples, which are not, however, driven home till the wire is "strained," as will be explained further on.

The usual distance between the wires is as follows:—

	Ft.	in.
From top of post to 1st wire - -	0	2
Between 1st and 2nd wire - -	0	10
" 2nd " 3rd " - -	0	$7\frac{1}{2}$
" 3rd " 4th " - -	0	$6\frac{1}{2}$
" 4th " 5th " - -	0	6
" 5th " 6th " - -	0	6
" 6th wire and surface of ground -	0	6
Total - -	3	8

which is the height of the post out of the ground. In soft yielding ground the posts are made two inches longer, and 1 foot 10 inches in the ground.

The wires are strained at each straining post by means of instruments called strainers and collars, which have been improved and simplified by Mr. Grant Thomson, and his forester, Sampson. I think it most important that we should adopt the wire fencing for our plantations and reserves in Madras, and that our assistants and overseers should make themselves thoroughly acquainted with the *modus operandi*, which is very simple. I thought of trying it before I came home in inclosing the Pulney Hill plantations, and some of the railway reserves near Trichinopoly, but was deterred by the expense, as furnished me by the manager of the Great Southern of India Railway. I now

see that the wire made use of by that company is galvanized and twisted, which I cannot think necessary, as the "best drawn annealed" wire is found to last well if coated with tar. This is done by Mr. Thomson the year after the fence is put up, so as to allow of tightening, straightening posts, &c. Both posts and wire are thickly coated, and in India we should probably have to creosote the portion of the posts let into the ground, or, in fact, the whole post.

The whole cost of the fence, as put up by Mr. Thomson, is 7½*d.* per running yard, which he computes thus :—

	d.
Wire, per yard - - -	- 3½
Posts (each post being 3*s.*, and standing two yards apart) - -	- 1½
Work - - - -	- 1½
Tarring - - - -	- 1½
Extra for straining posts and staples	- ½
Total	- 7½

The rolled wire is inferior in quality and in shorter lengths, and should never be used. I propose making inquiries as to the cost of shipping the drawn annealed wire to Madras, including insurance, &c., and shall have one or two of the improved Strathspey strainers and collars made, and take them with me on my return. The method of using them can easily be shown, but is difficult to describe in writing, and I have not therefore attempted it.

Floating.—This was formerly carried out to a large extent on the Spey and its tributaries, but is not now so much in use, and is quite discontinued on the Spey itself, owing to the construction of the railway and facilities for sawing up the timber in or close to the forest by means of portable steam sawing machines.

I visited one of the dams (known as the Big Dam) on the Nethy river in the Abernethy District, and made myself conversant with the methods adopted, which is simple and effective. By its aid, the trees are, in the case of the river or stream I allude to, floated right up to the saw mill (water) at Abernethy village.

I must premise that, were the stream to remain full long enough for the purpose, the logs would simply be floated down in the ordinary way (singly, not in rafts), watched and assisted by men on the banks; but this is rarely the case, and arrangements have to be made for storing water at several points on the way, which can be let into the main

stream as required in sufficient quantities to carry on the logs to their destination.

This is effected in the following manner :—

A temporary weir, constructed of logs and stones, is thrown across the river down which the timber is to be floated.

A channel is led from above this weir, to supply a reservoir made for the purpose, at the nearest eligible site in the vicinity of the river, the channel being furnished at its head with a sluice whereby the supply is regulated.

From the reservoir a channel is led to the river, meeting the river bank at a point considerably below the site of the weir, and this channel is also furnished, at its head, with a sluice whereby the supply to the river is regulated. By this arrangement water taken from the river, and stored in the reservoir, is capable of being used as an auxiliary power for floating the timber to a point considerably further down the river than could be reached by means of the water power in the river itself.

The various stages in the transit of the timber are these. It is floated by the available water-power in the river to a given point, and then stranded. Immediately below this point the temporary weir above described is constructed. This raises the water sufficiently to float the timber once more, and the weir being removed, the timber is carried on to a point further down the river, and again stranded. At this second point is the mouth of the channel led from the reservoir; the sluice at the head of this channel being opened, the water stored in the reservoir flows down the channel into the river, the timber is again floated, and is thus carried on to its destination.

There are, of course, as many dams as are found necessary along a river, and the process may be repeated as often as required.

The "Big Dam" which I saw was about 90 yards long, 10 feet high, and about 15 yards thick at the base, the sluice fitted with two doors or vents raised by a powerful lever, being in the centre. The reservoir, which covered a large area when full, can be filled in two to three days, and the water is sufficient, when let on, to keep the river in floating order for four hours. The accompanying rough sketch will perhaps explain better than any written description. (*Vide* Plate I.)

The work of construction is all done by the forest establishments, and though rough, and not calculated for the sudden freshes of an Indian mountain stream, it answers the purpose here, where, however, the men can be more relied on to go and open the sluice gates of the main dam,

or to shut that leading from the river, in the event of very heavy and continued rains. A self-closing sluice for the latter would probably be found necessary in India to prevent danger of the main dam being carried away or breached, or the simplest arrangement for safety would be an escape in the river bank, just above the weir, as shown at G in the sketch.

Saw Mills (*Water Power*).—I gave particular attention to the saw-mills and machinery throughout my tour, and here inspected that at Abernethy, to which the logs are floated down as already described.

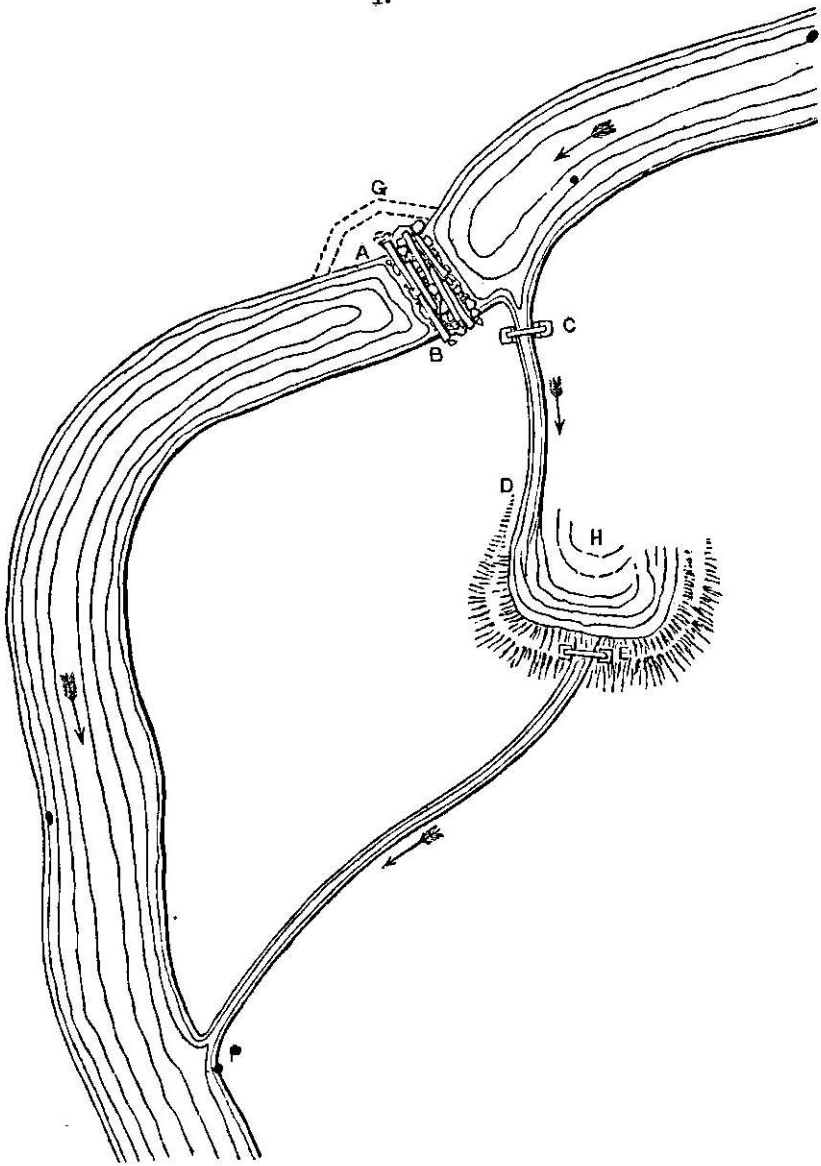
There are two wheels, drawing two separate sets of machinery, in adjoining sheds, one 14-feet breast wheel, with segment and 4½-feet drum, single action, driving four circular saws when required. The action is very simple and effective. The other is a small 4-feet breast wheel, turning a crank which works a vertical band-frame saw. (*Vide* Plates II. and III.)

This appears particularly simple and useful for squaring large beams, and could be easily constructed and put up in our Indian forests, having the great advantage that there is scarcely any iron employed. All there is could be easily done by a village blacksmith.

Grazing.—I made particular inquiries on this point, in order to ascertain the usage, as the case of this estate, with 60,000, acres under what may be called the Strathspey Forest Department, in the midst of a great grazing county, bears some analogy to the question in Madras, where every little inclosure for planting, or formation of reserves, is apt to be met with an outcry, as lessening the extent available for pasture. I have invariably argued in India that not only did our inclosures make no appreciable difference in the enormous extent of hill pasture available, to which they bear, and always should bear, a very small proportion, but that eventually grazing might be allowed in the plantations and reserves, and the pasture would be found to be improved. I now find that this is exactly the case here, where ordinary pasture land on the hill sides lets for 6*d.*, and that of inclosed plantations for 2*s.* 6*d.* an acre, the one being as strictly reserved to the renter only as the other.

The practice with existing woods or plantations, over 15 or 20 years old, is to let the grazing for a term of years on the condition that the renter puts up the fence and keeps it in repair, the landlord providing the posts in the first instance, but not the wire nor work. At the expiration of the lease, if not renewed, the landlord has the option of taking

I.

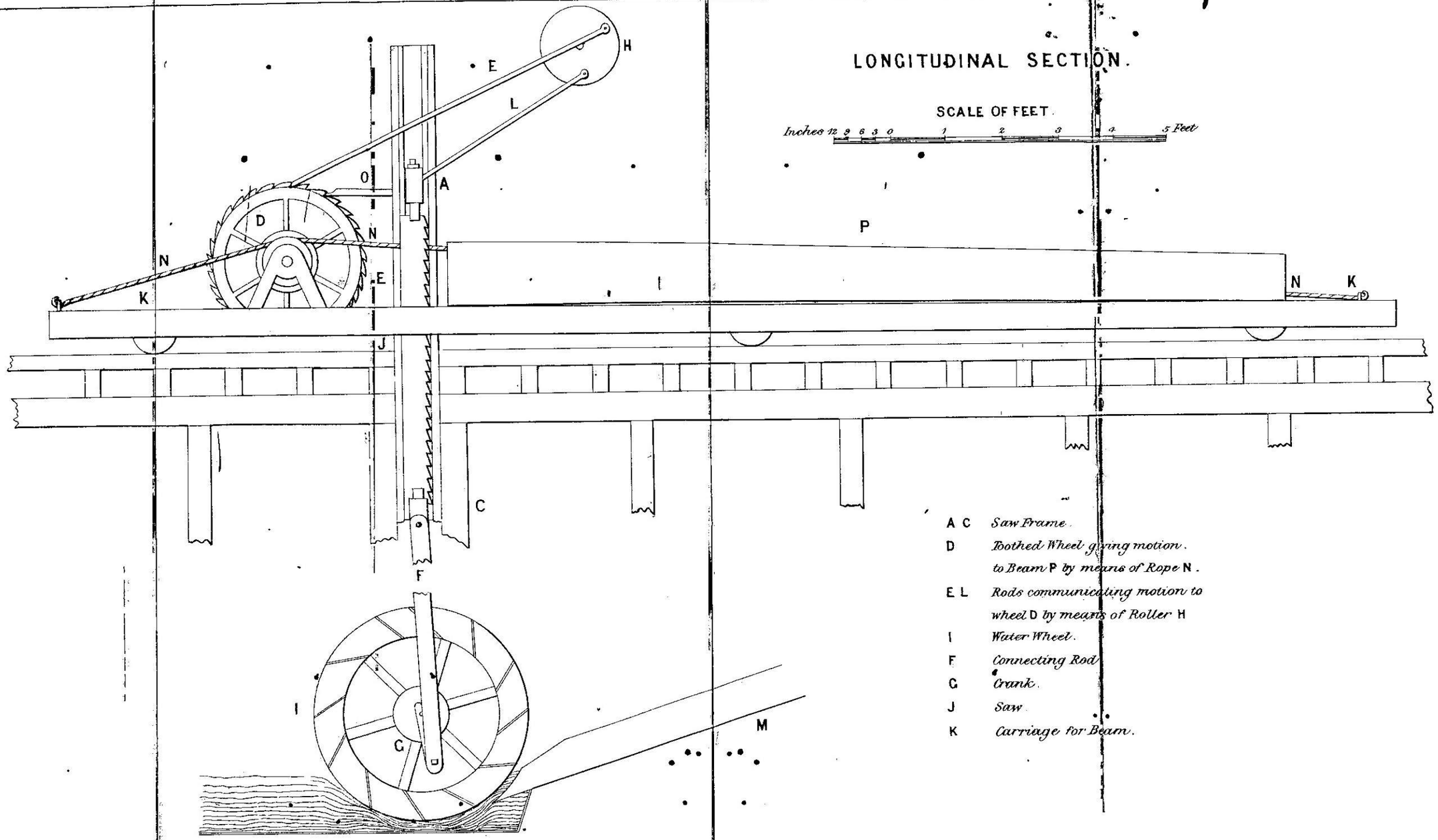


AB. Temporary weir constructed of logs and stones.
CD. Supply channel led from above weir to reservoir.
EF. Channel led from reservoir to river's bank.
G. Escape channel or bye-wash.
H. Reservoir.
E and C. Sluices at the heads of the two channels above named, to regulate supply from same.

LONGITUDINAL SECTION.

SCALE OF FEET.

Inches 12 9 6 3 0 1 2 3 4 5 Feet



A C *Saw Frame.*

D *Toothed Wheel giving motion to Beam* P *by means of Rope* N.

E L *Rods communicating motion to wheel* D *by means of Roller* H

I *Water Wheel.*

F *Connecting Rod.*

G *Crank.*

J *Saw.*

K *Carriage for Beam.*

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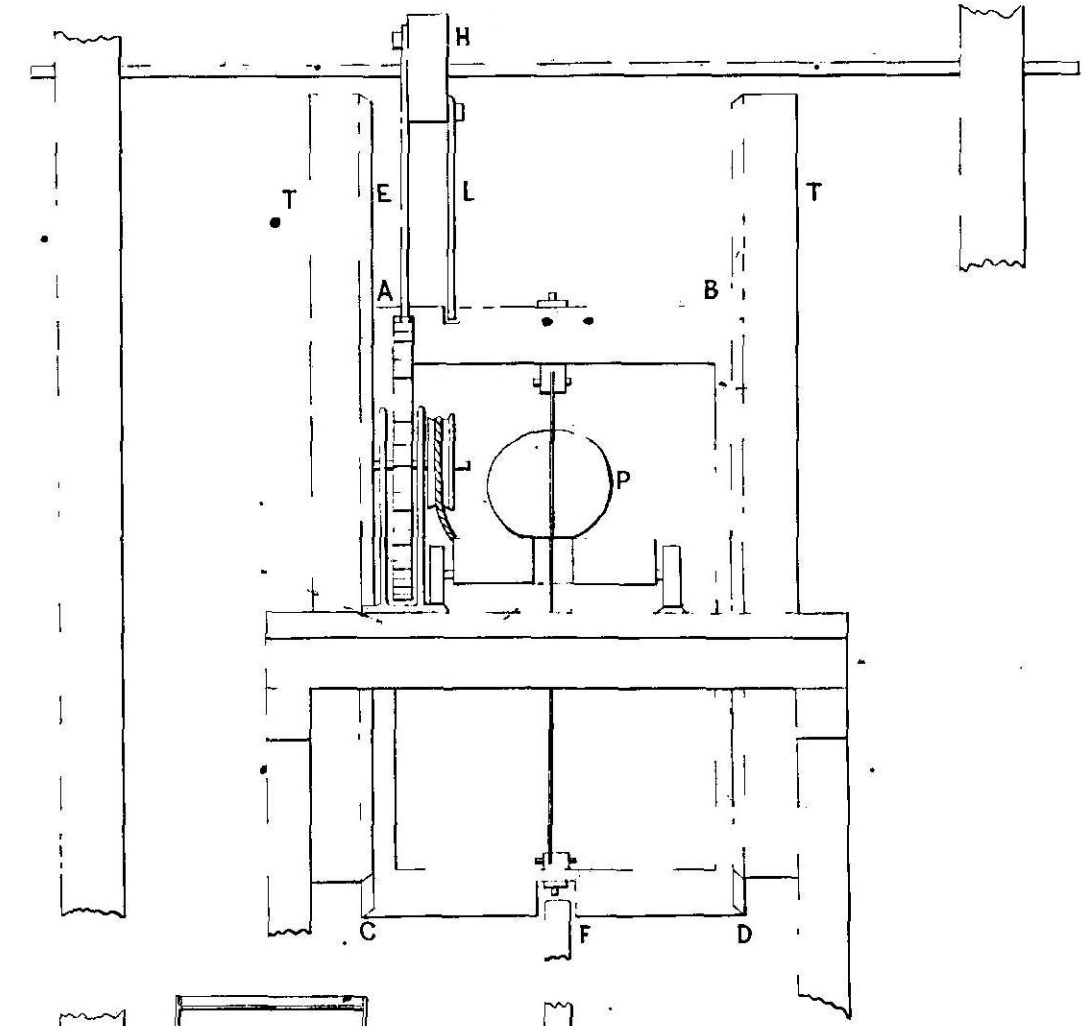
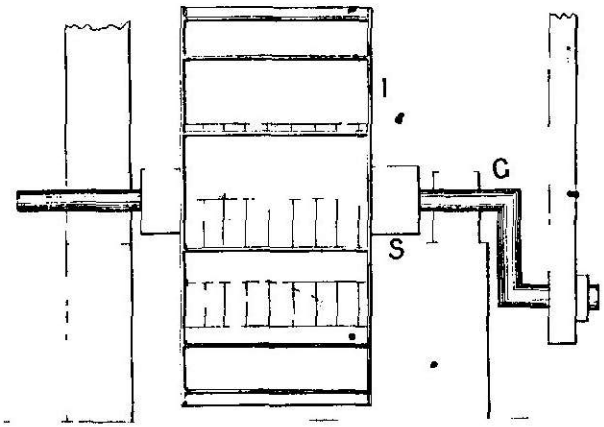
CROSS SECTION.

SCALE OF FEET

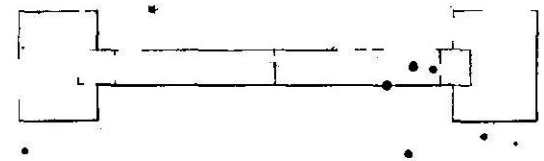
12 9 6 3 0 1 2 3 4 Feet

I *Water Wheel 4' Diameter 2' broad*
S *Axle of Do. 8" " 6' "*
F *Driving Rod 11' x 4" x 4"*
G *Crank of 2¾" Sq. Iron*
ABCD. *Saw Frame having 2 Vertical pieces, 3¾" x 3¾" x 3¾" and 2 cross heads 7½" x 3¾" Interior measurement 5'.4" x 3'.5"*
TT *Guides for Saw Frame.*





PLAN OF SAW FRAME.



Campbell Walker Del

Vincent Brooks Day & Son Lith

over the wire and work at a valuation, or arranging for the incoming tenant's doing so. The pasture, particularly under larch, is much better than elsewhere, and the trees afford shelter for the sheep from the excessive cold in the winter (as they would in India from the excessive heat in the hot weather on the plains, and on the hills from the rain and cold winds), whilst, on the other hand, the landlord gets an enhanced rent, and has his fences put up and kept in repair.

From young plantations or natural woods all men and cattle are rigidly excluded, as well as from tracts from which a crop of timber has recently been removed, and which, according to Mr. Thomson's system, is allowed to lie entirely fallow for some time. It often happens, however, that enclosures are made, or exist, before the forest establishments are ready to plant them. In these cases the grazing is rented, and often goes a long way to pay for the fencing. I trust we may yet arrive at some such system in India, allowing, of course, a wide margin for the people's actual requirements in the shape of grazing for their cattle, sheep, and goats, but not hesitating to take up, for planting or reserve, any of the residue which may be required to be thrown open again, or rented, as thought fit, when the trees have grown out of harm's way.

Explanatory Memorandum of Plates II. and III.

Vertical Saw Mill worked by Water Power.

This is effected in the following manner (see transverse and longitudinal sections) :—

Water is led along the shoot *M* on to the breast wheel *I*, acting on it partly by weight and partly by impulse, and escaping under the wheel. The wheel, in revolving, communicates motion to the crank *G*, which is attached to the driving rod *F*. This rod is secured to the bottom cross-head *C*, *D*, of the saw frame *A*, *B*, *C*, *D*. This frame works in guides, and it will be seen that the revolutions of the water wheel communicate vertical motion to the saw *E*, which is firmly secured to the cross-heads of the frame.

The beam to be sawn travels on a carriage *K*, to which slow motion is communicated by means of the rods *E* and *L*, the roller *H*, the toothed wheel *D*, and the cord *N*. This is so apparent from an inspection of the figure, that no detailed description is necessary.

The ratchet *O* falls into its place in the circumference of the toothed wheel *D* at each stroke of the saw, and thus keeps the wheel in its place.

The Earl of Mansfield's Woods, &c. at Scone, Perthshire, N.B.

These woods extend over about 10,000 acres, and are under the management of Mr. M'Corquodale, one of the most experienced of wood managers in this country, who has held the post for upwards of thirty years. He is aided by nine district foresters, and a considerable staff of permanently employed woodmen.

The country differs greatly from Strathspey, and even Blair Athole, as it is highly cultivated, and there are no extensive moorlands or pasture farms.

The plantations are therefore small in comparison, and in many cases extend over only a few acres, being surrounded by land under the plough.

This involves great expenditure in the formation and maintenance of the fences.

Mr. M'Corquodale informs me that he has no less than 600 miles of fencing to keep up, which of course includes the farm fences maintained by the proprietor. The soil being much richer than that of Strathspey, the growth of trees is more luxuriant. Mixed hardwood plantations were formerly extensively formed on the property, and the oak was looked upon as the standard and most valuable tree to grow; but this is now changed, and the conifers are receiving most attention, and appear likely to be the best paying crop, besides being the most useful for general estate purposes.

Nurseries.—There are two nurseries, one situated at Scone (about one acre), and another (two acres) at Logie Almond.

They are arranged in the manner already described, and appear in excellent order, containing seedlings and transplanted trees of the several descriptions of hardwood and *coniferæ.*

Amongst the former I was struck with the oaks and sycamores, some beds of which average fully eight feet in height, being retained in the nurseries for avenue planting, which I saw being carried on in the neighbourhood of Logie Almond.

Mr. M'Corquodale tells me they have no difficulty, and few losses, in planting out such large trees, which are two-years seedlings thrice transplanted, *i.e.*, five years old before being put out,—as the roots are rendered very healthy and fibrous by the frequent transplanting, and soon shoot out in the pits which are 40 inches square.

Another noteworthy feature in the nurseries is the fine stock of *P. Douglasii* of all ages. Mr. M'Corquodale has given this tree much attention, and speaks very highly of it, both for ornamental purposes and planting to profit. At Loch Almond there are a few *Abies Nordmaniana* seedlings, which promise well as ornamental trees for the policy grounds.

Mr. M'Corquodale showed me a bed which had been sown with Indian (Himalayan) tree seeds, sent to him by Dr. Cleghorn. They comprised *Pinus excelsa, Cedrus deodara, Abies Smithiana,* and *Picea Webbiana.*

The *Pinus excelsa* had germinated fairly, but of the other descriptions few have come up at all. Greater care would appear to be necessary in selecting and packing the seed.

Mr. M'Corquodale is very willing to experiment with all descriptions of Indian tree seeds, and great attention is paid to the sowing and transplanting so as to ensure success, if possible.

Plantations.—I visited nine plantations or places where planting operations had been or were being carried on.

The oldest trees which I include under this head are, in this case, 25 years old, and average from 35 to 40 feet in height. A small plantation (22 acres) of Scotch fir of this age was visited by Dr. Brandis five or six years ago. Dr. Brandis then considered it too thin, but since then it has been twice thinned, and, according to the system pursued in this county, does not appear too thin now.

Mr. M'Corquodale lays it down as a rule, that the average distance between trees in a plantation should be one third their height. Thus, if trees average 30 feet high they should stand at 10 feet apart, and so on.

He showed me a very simple method of estimating the height of trees by the eye, which I think will be useful in India in making forest valuation surveys, &c.

The second plantation which I visited was a pinetum with larch nurses, being a portion of a 55-acre enclosure. The trees are about 20 years old, and comprise *Menziesii, Laricio, Austriaca, nobilis,* and *excelsa.* The *Menziesii* shows by far the finest growth, the next best being the *Laricio,* which shoots up rapidly, but presents a bare appearance. The black *Austriaca* are very robust, but coarse in their habit.

There is a considerable quantity of *P. montana,* a dwarf species planted for underwood as cover for game.

Mr. M'Corquodale intends gradually removing all the larch, and leaving the pine plantation as an experiment,

using the thinnings for posts, &c. on the property to test the value of the several descriptions.

Near this is a 13-acre plantation of the Douglas pine planted out 10 years ago, as two years seedlings twe transplanted.

They are planted in pits 15 feet apart, 15 inches square, and 10 inches deep, with larch and Scotch fir nurses at about four feet apart.

The Douglas pines are doing very well, and average fully 25 feet in height.

The nurses are now being gradually removed.

The pits cost 4*s.* per acre, containing about two hundred.

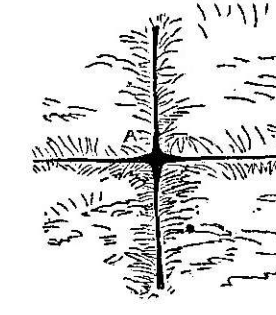
At Lynedoch we inspected a mixed plantation of Scotch fir, larch, and spruce, all doing fairly, and on an adjoining piece of moorland I had a favourable opportunity of seeing draining and planting operations in progress.

The drains were 36 feet apart, 2 feet deep, 2½ feet wide at top, and a spade's width (or about 1 foot) at bottom, the main drain being 3 feet deep, and 3½ feet wide at top.

The land is very spongy, with a clay soil at top, but gravel is reached at two feet from the surface. It is being planted with Douglas pines in pits, as already described, and made up with larch at about six feet, and Scotch fir at about three feet apart.

The nurses were being put in on what Mr. M'Corquodale terms the "double notch system," an idea of his own which he finds efficacious in fixing the young tree very firmly in the ground.

It consists in making two cross cuts with the spade instead of one, as is usual, canting by a turn of the wrist a portion of the turf a little to one side on making the second cut, introducing the plant at A, and passing it along to B, then treading the turf well down all round.



The men do this very quickly after a little practice, and the plan seems a very good one.

As already stated, Mr. M'Corquodale does not consider it impossible to re-plant land from which a crop of timber has

been recently removed, and does not agree with Mr. Grant Thomson that it is necessary to wait until the natural herbage or vegetation returns; but he does consider, that in order to plant such land successfully, special treatment is necessary.

He appears to have given the matter much attention, and has arrived at the conclusion that it is the beetle, and the beetle only, which interferes with the growth of young trees planted on land recently cleared of conifers. He has contributed several papers on the subject to the Scotch Arboricultural Society, and tried various methods for overcoming the difficulty, arriving at last at the following, which he has now no hesitation in recommending.

Allow the land to lie entirely waste for one year, excluding all cattle and sheep, in order to allow grass, &c. to grow. Then burn it when dry, and plant out by the double notching system.

This plan should not cost more than 15*s.* per acre, all told, and the saving by not allowing the land to lie waste for a number of years, as in Strathspey, is very considerable.

Mr. M'Corquodale also succeeded in raising the young trees, after a "clean cut," by burning and pitting, but this was too expensive, amounting, in one instance, to 45*s.* per acre. I saw plantations of both descriptions, and can vouch for the trees being healthy, and having attained to heights of 30 and 35 feet in 24 years, and from the one last alluded to as pitted 40*l.* was realized last year by thinning 20 acres. This plantation was originally very unfortunate, 32,000 young trees having been "thrown out" of the ground by severe frost during their first winter, which raised the expenditure to 45*s.* per acre, as already stated.

The other plantations visited do not demand special notice, save a fine piece of Scotch fir, extending over 60 acres. This was planted about 20 years ago, and the trees, which now stand eight or nine feet apart, average fully 30 feet high. The thinning of this wood, two years ago, realised 60*l.*, and it will be thinned again next year.

Woods.—In the Policy Grounds adjoining Scone Palace and Logie Almond are some very fine specimens of *P. Douglasii, Menziesii, nobilis,* and *excelsa* (Indian), and old Scotch firs and beech of great size.

Close to Scone there is an oak wood, with hazel undergrowth, containing some very fine trees, one of which was measured two years ago by Captain Douglas and Mr. M'Corquodale, and found to contain upwards of 100 cubic feet of

timber, being then 63 years old, and there are many nearly as good in the vicinity. Mr. Brown appears to have measured this same tree in 1850, and found it to contain 48 cubic feet, and if this is correct, and the measurements were both conducted on the same system, it appears that the cubical contents has more than doubled in 13 years, which is very remarkable.

In another wood of 30 acres, 50 years old, mixed hardwoods and larch, the growth of the former is very fine, but I did not obtain any measurements.

There is a considerable extent of oak coppice on the estate, but the rates now realized by sales are not remunerative, and Mr. M'Corquodale is therefore not extending it, but prefers keeping the best oaks as standards and planting Scotch firs.

I saw several oak trees of various ages pruned, and the selection of Scotch fir and spruce to be felled in an old wood.

Timber here realizes rather more remunerative rates than Strathspey or Dunkeld, as the woods are close to a market at Perth, and the surrounding country is highly cultivated.

Fencing.—Mr. M'Corquodale's wire fences, which are very substantial, cost him only 6*d.* per running yard. He has a greater command of labour than Mr. Grant Thomson, and the carriage of the wire is less. He states that he seldom uses the "collar" to hold the wire when straining, finding an iron wedge sufficient. He uses the strainer referred to in the report on Strathspey, which he finds the best.

Saw Machinery.—I inspected a portable steam-engine at work for a wood merchant, who spoke very highly of its work, and stated that he had had the same engine at work for several years in different places.

This engine is by Abernethy of Aberdeen, 20-horse power, with 15-inch cylinders on the same principle as that of Chrystie of Perth, of which I have obtained plans and specifications. It is adapted for burning wood chips and shavings, the refuse of the trunks sawn up.

The Duke of Athole's Woods and Plantations at Blair Athole and Dunkeld, Perthshire, N.B.

I spent several days in visiting these woods, and met with great attention from Mr. M'Gregor, the Duke of Athole's wood manager.

The woodlands extend to upwards of 10,000 acres, divided into five districts (including Strathord, which is detached from the rest), each under a separate forester.

The first systematic planting was commenced in 1728, by Duke James, who caused extensive plantations of larch and spruce, particularly the former, to be formed; and, until a comparatively recent date, these descriptions were mainly planted without much consideration as to the nature of soil and exposure. The Scotch fir has, however, been largely introduced during the past 50 years, and, as a rule, appears better suited to the soil and climate. Here and there the larch has done very well, and surpasses anything of that description in Strathspey.

The Nurseries at Ladywell adjoin Mr. M'Gregor's house, and cover about four acres. They are well stocked with young trees, both hard-wood and coniferous. Amongst the former, the sycamores (*Acer pseudo-platanus*) are particularly fine, being grown for avenues, transplanted in the nurseries for several years, and put out 10 and 12 feet in height.

There is another small nursery at Blair, near the castle, in which seedlings for that district are reared.

Plantations.—I visited six plantations; they are mostly of small extent. The great difficulty which Mr. M'Gregor has to contend against is game, particularly rabbits, hares, and fallow deer. The only plans to adopt would be those carried on by Mr. M'Corquodale at Scone, viz., wire netting round the fences, and "cradles" or other protection to each tree; but anything of this sort adds considerably to the expense, and can never be generally adopted in extensive planting operations. The truth of the saying that "you cannot rear "both young trees and game at the same time" is fully corroborated in the case of the Duke's estate.

At Blair some 300 acres are now being planted with Scotch fir and larch; and in an old larch plantation, which has been thinned out to about 150 or 200 trees to the acre, the plan of slitting in larch and Scotch fir as a second crop is being tried.

Near Dunkeld, 100 acres of Scotch firs, mixed with a few oaks as standards, planted some years ago, are doing fairly, but has a patchy appearance owing to its being overrun with game, particularly fallow deer. In another place there are 36 acres of mixed hard-wood and Scotch fir, which is doubly enclosed, and now doing pretty well, but has been twice replanted owing to the devastation caused by game. An adjoining piece of 170 acres has not been planted up, as Mr. M'Gregor sees little use in doing so unless the rabbits and hares are shot down. In the same block, 22 acres of old wood has been left standing as a screen, and in the hope of natural reproduction, which, it is worthy of note, the game do not attack so much as trees planted out from the nurseries; probably because, in the former case, the young trees come up very gradually, and do not attract the attention of their deadly foe, the rabbit, so much as those which are put out 8 or 10 inches high.

In a plantation about 20 years old behind Mr. M'Gregor's house, the larch are much affected by disease, both blister and dry rot, and cannot be said to be thriving. The Scotch fir in the same plantation is healthy; the trees average 18 to 20 feet in height.

Close by is a mixed hard wood and Scotch fir plantation, in which the former, particularly the sycamores, are doing well; but here again, and in a large tract of 350 acres which I saw the same day, the damage done by the game is great.

Self-sown Fir.—I only saw one piece of about 10 acres, and Mr. M'Gregor informs me that it is the only one on the property, excepting a small piece at Strathord.

There is a considerable quantity of self-sown or indigenous birch, which is sold by weight at from 6*s.* to 10*s.* per ton, dragging and carting expenses, and, in some cases, the cutting being borne by the purchaser. The wood is much used for the manufacture of bobbins and the refuse for charcoal.

Woods.—These are mainly larch, for which Duke James and his immediate successors had a great predilection. It has in many cases been planted in unsuitable soil, where the Scotch fir would have done much better, and yielded a much better return. The Duke's idea appears to have been to make use of it for ship-building, after floating down the Tay to Newburgh, and thence to Dundee. I believe only one man-of-war, a frigate called "The Athole," was ever constructed of it, but do not know how it answered.

The disease which has attacked the larch within the last 30 or 40 years, the great fall in price owing to its disuse for ship-building, the introduction of foreign timber in large quantities, and more recently the substitution for many purposes of iron for wood, has falsified all the calculations as to the value of these woods, so much so that what was estimated to be worth 1,000*l.* per acre when mature would not now realize more than 150*l.* to 200*l.*

The disease to which I have alluded does not appear to have existed until within the last 30 or 40 years, but is now very common, in fact universal, and there would appear to be no remedy for it short of cutting out all diseased trees and replanting; even then it is doubtful whether it will not reappear in the new crop. It is said to be atmospheric, and first makes its appearance in a fungus-like growth on the stem of the tree, generally near the axils of the branches, then developes itself into or produces a blister, and eventually a hole or wound as if a branch had been roughly broken off.

There is a fine larch wood, extending to 3,000 acres behind and above Dunkeld, and covering the whole of Duchray Hill, to the top of which we ascended (1,600 feet above the sea). This extensive forest has now been cleared out to an average of 100 trees per acre, and those near the base of the hill are very fine and healthy. On the higher slopes the growth is superior, and there appears little doubt that the Scotch fir is much better adapted for such exposed situations. There is a good deal of spruce in the hollows, which does not as a rule present a healthy appearance, little regard having in former years been paid to drainage. On the opposite hills a tract of almost equal extent was planted, but it has not done nearly so well.

Above Inver there is a wood known as Craigvinean, extending over 800 to 1,000 acres of larch and spruce, with a little Scotch fir, which is the finest I saw on the estate. It has been thinned out to 150 to 200 trees per acre, and a little thinning of "back-going trees" (that is, those which have passed their prime) is now going on.

In the Policy Grounds at Castle Blair there are some very fine specimens of larch trees over 100 years old, and some of the original Scotch firs planted in 1738. Both descriptions are of great size but of straggling habit, not having been trained as in regular crop. The grounds also contain some fine specimens of the *P. Douglasii*, *P. nobilis*, *P. pectinata*, *Cupressus Lawsoniana*, *C. torulosa*, &c., and

near the "Hermitage" at Dunkeld are some very fine Scotch firs and specimens of *Abies Mexicana, Menziesii*, &c.

Mr. M'Gregor approves of and carries on the removal of the dead lower branches from the larch, which he finds can best be done in very dry clear weather, whether warm or frosty, as the branches are then brittle. He does not practise this system with the Scotch fir or spruce.

The methods of thinning, cutting (by cross-cut saw), and sales do not differ materially from those in force in Strathspey, and the classes into which the trees are divided, viz., timber, spars, and props are identical, but Mr. M'Gregor adds a fourth class of thinnings under 3 inch diameter, for which he finds a sale. He gives the average rates as follows:—

Larch—timbers, 1*s.* per cubic foot.
" spars, 2*d.* per running foot, measured lineally to 6-inch diameter.
" props, 4*s.* 6*d.* per 100 running feet, measured lineally to 3-inch diameter (or a little over ½*d.* per foot).
" 4th class (as above), 2*d.* to 4*d.* each, according to situation.

Note.—Larch bark, which is used for dressing sheepskins for satchels, bookbinding, &c., realises about 3*l.* per ton.

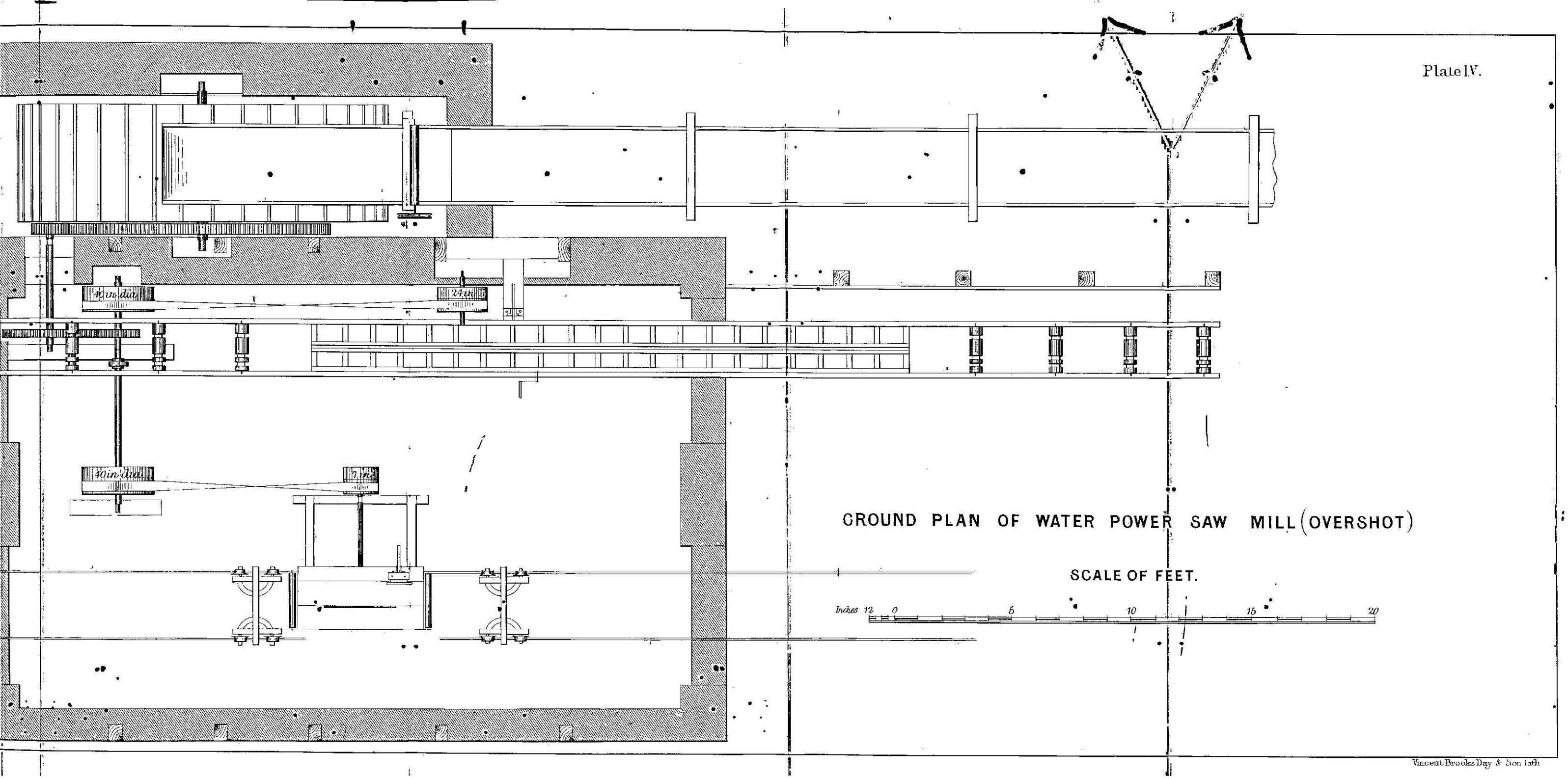
Scotch Fir.—Timber, 8*d.* per cubic foot.
" Spars, 1¼*d.* per lineal foot.
" Props, 2*s.* 6*d.* per 100 feet.

Spruce used to realise about the same, but has been reduced to 5*d.* or 6*d.* per cubic foot to effect sales.

Oak Woods and Coppice.—There are about 1,200 acres under oak, of which I visited several tracts. The oak coppice is cut periodically at intervals of from 20 to 25 years, the standard trees, which are not to be felled, being previously marked, and those of any size numbered consecutively.

The average price realized for oak coppice does not now exceed 10*l.* or 12*l.* per acre, including, of course, both the timber and bark (the former does not now fetch more than 1*s.* per cubic foot). Mr. M'Gregor has known it reach 20*l.*, but it was quite an exceptional case. The great fall in price has resulted from other substances being used for tanning, and on account of large importations of foreign bark. The value of the timber has declined, owing to its almost universal supersession by iron for ship-building purposes, for which, in ironclad men-of-war, a teak backing is

Plate IV.



GROUND PLAN OF WATER POWER SAW MILL (OVERSHOT)

SCALE OF FEET.

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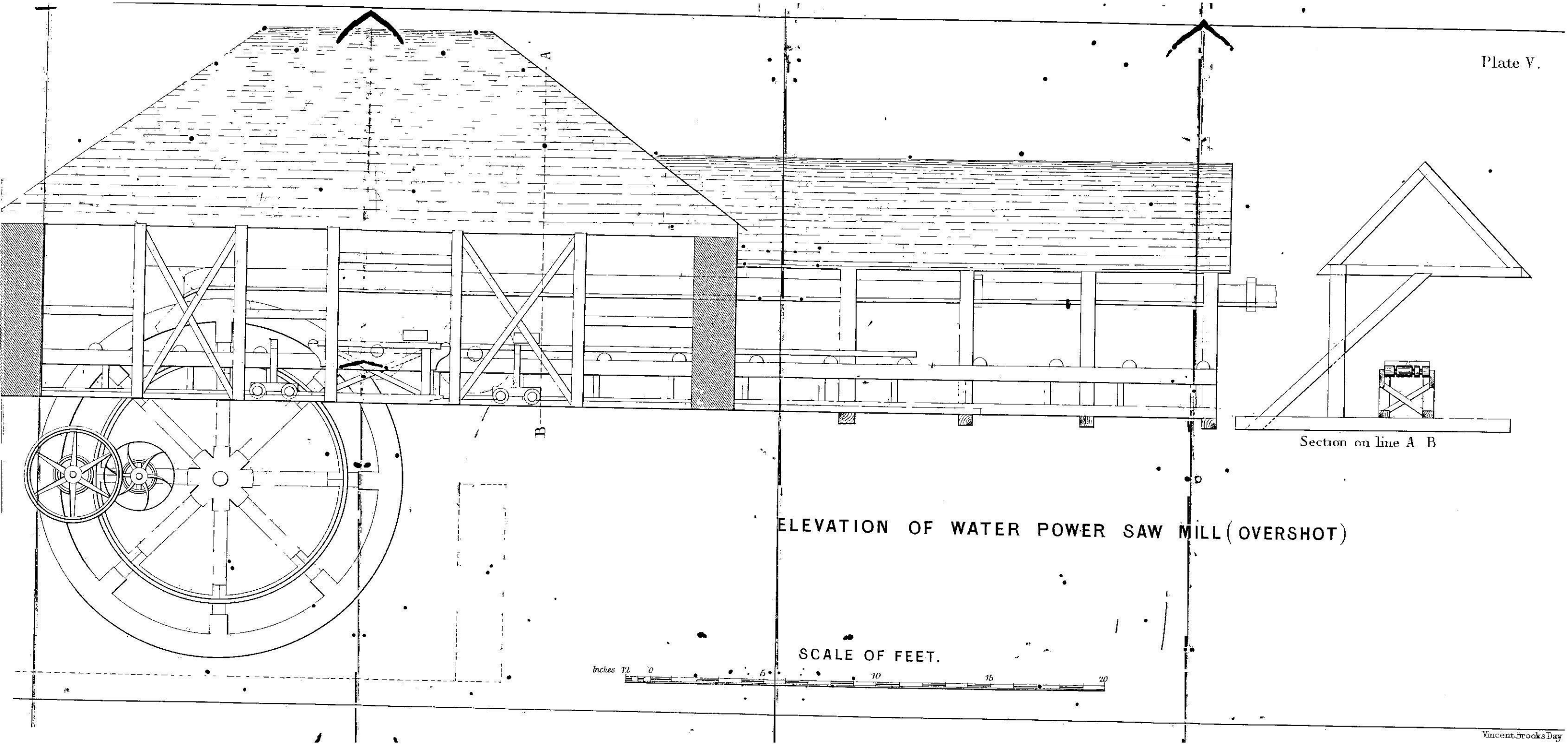

Vincent Brooks Day

generally preferred. Oak coppice is thus no longer remunerative, and does not receive so much attention as formerly.

Birch, of which there is a considerable quantity, sells, as as already stated, by weight at 6*s.* to 10*s.* per ton.

There is at present little or no supply of other timbers, and the demand for anything, except larch, spruce, and Scotch fir, of which any quantity can be sold, is scarce.

Mr. M'Gregor is surface draining the marshy places in the same manner as described under "Lord Mansfield's Woods."

Wire Fencing.—All now being put up is of wire, with wooden posts, and differs in no material point from that described as adopted at Strathspey, save that here as a rule the work is executed by the regular establishment, and posts are cut up for the purpose, not purchased, which renders the actual cost per running yard difficult to ascertain exactly.

Saw Mills.—I visited four on the Duke's property, viz., three water power and one steam.

Of the three water-power mills, one (close to Blair) is small, and devoted entirely to working up wood for estate purposes. The other two are very powerful, and leased to wood merchants, the proprietor keeping up the machinery. (For specimen working drawings, *see* Plates IV. & V.)

The saw mills were all at work when I was there, and there seems little trouble in their management. They are fitted with long and short benches and appliances for boring holes and fitting ends for hurdles. That at Inver, which I saw last, and which is the most powerful, has also attached a very simple apparatus for crushing the bark and filling sacks with it, which has hitherto been done by manual labour with the aid of flails.

III.

Extracts from Reports by Mr. Gustav Mann, Assistant Conservator of Forests, Bengal.

SCOTCH FIR FORESTS OF LÜSS, BEECH FORESTS OF THE DEISTER AND SOLLING, SPRUCE FORESTS OF THE HARZ.

Cultivation and general management of the "Lüss" Scotch fir forests.

At the Lüss forests, and especially near Niebeck, I received instructions in the very extensive and most successful cultivation of the Scotch fir, as well as in the general management of these forests.

In the plains of North Germany the Scotch fir is the principal forest tree, and better suited for deep, loose, and sandy, than for heavy, loamy soil; it gives a fair amount of timber, and from these forests is chiefly applied for local building and other purposes.

The branches and rootstocks are used either for the burning of charcoal or as firewood.

Situation of the Lüss forests.

The Lüss forests are situated about half way between Hanover and Harburg, and constitute part of the great "Lüneburg Heath."

It is that portion of the province of Hanover in which the forests are most extensive, although from causes similar to those which tend to destroy some of the Indian forests, viz., the indifference of the inhabitants to the existence of forests, originating in the common belief that they will continue to exist, no matter how recklessly treated, the desire of the villagers to get grazing ground for their cattle by burning the forests, the indiscriminate usage of the wood, and method of felling in vogue, hundreds of miles of forest have been destroyed in former time, and have left the greater part of the "Lüneburg Heath" barren, covered almost exclusively with heather, and of little use to any one.

It is with a view of restoring these forests that at present much skill and labour, as well as large amounts of money, are being spent in getting up new forests.

Cultivation on land with a subsoil of moorpan.

For the successful cultivation of the Scotch fir in the Lüss forests the moorpan, so prevalent in these plains, had frequently to be broken through.

Near Niebeck alone there are about 1,000 acres brought thus under cultivation, and nearly all within the last three years.

This area was generally broken up in strips, eight feet wide, leaving between strips of six feet in width untouched.

This was done partly by ploughing where necessary to a depth of two feet, and in places where even this was not sufficient to break through the moorpan, it was done with the spade by men trenching the soil.

The average cost of thus preparing the soil for these plantations has been 18*s.* 3*d.* per acre, which would be very high if it was not considered that by so doing the soil was redeemed for cultivation.

The material for planting consisted of one-year old seedlings of Scotch fir, and occasionally a two-year old seedling of spruce, which are raised in the ordinary way by sowing in furrows.

The planting is done with a wedge spade, which is constructed in one piece out of beechwood, shod with iron, and 3′ 4″ long from the handle to the edge.

The blade alone is 11½″ high, half as broad, and 2″ thick at the top (Fig. 1.)

Fig. 1.

With this spade one man proceeds along the prepared strip or bed, making holes at distances 3′ × 5′ by simply treading the spade into the soil, and he is followed by two women, who plant by holding the young seedling firmly with their left hand against one side of the hole, whilst with their foot they press the soil from the opposite side towards the plant.

The average cost of such planting has been about 5*s.* 8*d.* per acre.

Where sowing was adopted instead of planting the ploughed or trenched strips were first levelled with a harrow, and after this the seed sown at an average cost of 1*s.* 4*d.* per acre, 3 lbs. of Scotch fir and 1 lb. of spruce seed being used for sowing one acre, the cost of which is not included.

The filling up of vacancies afterwards came to 1*s.* 6*d.* per acre, and the average of the total expenditure of getting up these plantations was 1*l.* 5*s.* 6*d.* per acre.

These forests are of greater value by being situated alongside of the Hanover and Harburg line of rail, as the thinnings and so forth are readily disposed of; but by this they are also placed in great danger from fire during hot and dry summers, since the sparks flying from the engine often light

the accumulated fir leaves, dry heather, and other smaller plants.

Protection of forests against fire.

To guard against this danger, so called "safety strips" of other kinds, not conifers, are planted along the line of rail, as, for instance, birch, coppice wood of oak, &c.

Something similar might be carried out in India, with a better chance of keeping out fires than there is at present, and at reasonable cost.

Danger to forests from insects.

I had frequent opportunities of witnessing the damage done to the Scotch fir forests by insects, and the means adapted to prevent or diminish it where possible.

Whilst the young trees suffered most from the larvæ of may-bug (*Melolontha vulgaris*), and a little beetle (*Curculio* (*Hylobius*) *pini*), the old trees were frequently destroyed by beetles (*Bostrichus*), attacking the bark which necessitates occasionally the cutting down of whole forests, since wind and storms, admitted through the open spaces caused by the attack of the beetles, would soon overthrow the rest of them.

Caterpillars also frequently damage the young Scotch fir by eating the leaves, thus making the plants sickly, and rendering them more liable to attacks from other insects.

General management of Scotch fir forests.

The Scotch fir requires more light and air than any other, and does not thrive at all in the shade of other forest trees.

For the same reason natural reproduction is very difficult, and only practicable under very favourable circumstances, and not attempted here, where it is grown in regulated forests with complete clearances and re-stocked by sowing or planting.

As a tree affording some shade to other kinds who require it the Scotch fir is well suited.

If sown or planted very close early attention to thinning out is also necessary, as plants early stunted never fully recover their strength.

The soil not being rich the trees are not allowed to grow older than 60–80 years, this being the age at which the comparative yield of wood is the best.

For the production of large timber the soil is not good enough, and therefore this is, as a rule, not attempted.

The holding over of a few selected trees to grow as many years again with the succeeding generations is not advisable in these forests either, as the storms and winds are too violent.

Fellings of the Scotch fir, as of all other kinds, are proceeded with from east or north-east to west or south-west, to secure the shelter of the old forest, which remains standing.

As before mentioned, spruce is planted in small numbers with the Scotch fir, and even where the soil is not good enough for it to grow up into large trees with the Scotch fir it becomes beneficial to the latter by the cover it affords to the soil through its denser foliage, thus facilitating decomposition of the soil, and keeping it moister and cooler than the Scotch fir alone would be able to do.

Manufacture of charcoal.

The making of charcoal in the forests is kept up to some extent, not that much revenue is derived from it, but it covers the expense of getting the stumps out of the ground and the branches collected, whereby danger from insects is removed, as this old wood is their chief breeding place, besides the loosening and clearing of the soil afforded by the digging up of the former.

I took this opportunity of getting instruction in charcoal burning, in which economy is sadly wanted in India, especially in the tea districts.

Nienburg Scotch fir forests.

At the Nienburg forests, to the north-west of Hanover, which also consist chiefly of Scotch fir, I received instructions in the cultivation and management of forests in low situations.

As the Lüneburg forests are remarkable for their dryness and the general want of moisture and water, so are these particularly instructive on account of their low, swampy character.

Cultivation and drainage of swampy forests.

Drainage is the only way by which such ground can be made fit for forest growth, and has often to precede by several years the planting, since the ditches cannot be made sufficiently deep at once, as they would soon be filled up again by the falling in of the sides.

A regular network of ditches, distributed over the ground after a well-considered plan, as well as the spreading of the soil taken out of the ditches over the surface of the beds between, are the ordinary means of rendering such localities fit for cultivation.

Previous turning over of the soil is here as everywhere followed by superior growth, justifying it whenever the funds are available.

Spruce in exceptionally wet places were even planted on the top of the soil, and their roots surrounded with earth, which answers admirably.

Moorpan in wet localities is not found quite so troublesome as in dry, but repays here also the expense and labour of breaking through it.

The general appearance of young Scotch fir on these beds between the trenches was very promising, whilst the

same tree on simply harrowed ground looked very healthy, but without the same vigour, showing that by the digging of the soil the plants gain several years.

Deister and Solling Hill beech forests.

At the Saupark forests, on the Deister Hills, I received instruction in the cultivation and treatment of beech forests, which studies I continued also on the Solling Hills.

Both localities are south of Hanover, and contain some of the richest forests in the province.

Use of the beechwood.

The beech is very extensively grown in Germany on account of the great value of its wood as fuel, for which it is chiefly used.

As timber it has been found to answer for shipbuilding, railway sleepers, the manufacture of furniture, cartwright work, and many other minor purposes.

Improvement of the soil by the beech.

No tree is more adapted for keeping up the quality of good forest land and for improving inferior soil than the beech, and it is cultivated wherever the soil and the climate permits.

It ascends in North Germany to a height of about 2,000 feet, above which elevation its cultivation ceases to be remunerative.

Lime and red sandstone hills like these are best suited for the beech, and allow it to attain great perfection.

Raising beech forests by sowing and planting.

Seed beds for beech are prepared in the ordinary way, and the seed is sown in autumn as well as in spring.

If the former time is preferred care has to be taken that the seed does not germinate too early, so as to be exposed to spring frosts; this is prevented by covering over the beds after the surface gets slightly frozen, and by removing the covering in spring so late that the young seedlings have nothing more to fear from the frost.

If sown in spring the seed has to be carefully stored during the winter. Steaming, as well as excessive drying, must be guarded against; the first is avoided by turning over the seed or even keeping it spread out; the second by slight watering it and turning it over afterwards, so as to distribute the moisture equally.

A cool moist room on the ground floor is preferable to a warm and dry one.

From the seed beds the plants are either removed at once into the forest or into other nurseries for transplanting, and keeping until they reach a height of 3–4 feet.

If they are to be planted in open ground, without the protection of old trees, they are sometimes kept in the nursery until they reach a height of 10–12 feet, which how-

ever is a very expensive measure, and only adopted in exceptional cases.

In this case care is taken that the young shoots are not removed from the stem, as the bark of the beech is very easily burnt by the sun, and otherwise apt to be damaged by the weather.

Unnecessary exposure of the roots of the young beech is carefully avoided, as they are very sensitive, and demand special care during the removal of the plants.

Where it can be done, some of the soil is left on the roots for the same reason.

Natural reproduction in beech forests.

Ordinarily the beech forests here get re-established by natural reproduction, *i.e.*, the shedding of seed from old trees.

Where the beech occurs mixed with other kinds, as in the coppice with standards, its regeneration is furthered or checked according to circumstances, but planting is seldom resorted to.

In the pure high forests of beech the natural reproduction is brought about by gradual and well considered fellings, which tend to effect this as completely as possible. In hilly or mountainous localities fellings are commenced at the top of the hill.

These fellings take place when the trees have reached maturity, and are 3–4 in number, and distinguished according to the immediate effect they are intended to have on the forest.

The preparatory cutting.

The first felling, called in Germany the preparatory cutting (*Vorbereitungs hieb*), is intended to facilitate the decomposition of the dry leaves and branches which cover the surface, and thus prepare it for the reception of the seed, which latter, without this precaution, frequently germinates without being able to penetrate with its roots the comparatively hard and leathery leaves lying on the surface, and often dies in consequence, whilst weeds and scrub easily get up in it, and cover the surface soon, thus adding to the difficulties to be overcome by the young plants.

It is commenced several years before the intended regeneration, and carried out gradually, but where the air and light thus admitted is not sufficient to render the surface fit for the reception of the seed, a timely permission to villagers to remove some of the dead leaves is resorted to.

Besides the preparing of the soil, this opening out of the forest induces the tree to flower and bear seed more frequently than when standing very close.

The seed cutting.

The second felling, the so-called seed cutting (*Samenschlag*), is carried out as soon as the bearing of seed becomes probable, which can be judged of beforehand by the appearance and the shape of the buds during the preceding winter.

An abundant seed-bearing season generally occurs with the beech after longer or shorter intervals, but sufficient seed for the regeneration of the forest may be reckoned on every second or third year.

Precaution is used not to remove too many trees at once, as in case of the flowers being destroyed by spring frosts or from other causes, the restocking of the ground with young plants does not succeed; too much light would dry up the surface of the soil, and induce the weeds to overrun the ground, both circumstances seriously interfering with the germination of the seed at a future season.

Where at this time the suitability of the soil or a portion of it remains doubtful, a timely loosening and preparing of it in strips or patches is resorted to to ensure success.

Where the expected seeding of the trees turns out a failure further clearing is carefully avoided to prevent the deterioration of the soil or overgrowing with weeds; if, however, the season is a favourable one, and produces sufficient seed, and the young plants germinate, this felling is soon extended to a greater number of trees, to admit more light and dew to strengthen the young plants.

For the purpose of getting the seed worked into the ground, herds of swine, cattle, etc., are often driven through the forest with good results.

Seed beds are sometimes established in the neighbourhood of a forest at the same time to furnish young plants for the filling up of vacancies, which, however, are also obtained nearly as good out of the forest itself from places where the plants stand thick enough to admit of it.

Altogether the aiding of the natural reproduction by artificial means, either sowing or planting, is at the present time generally resorted to at once, as such measures always lead to a more satisfactory accomplishment of the desired regeneration, and save time.

The amount of light to be admitted by this felling varies greatly according to soil, position, if in the plains or in the hills, and the exposure of the forest.

Success of the natural reproduction in the beech forest must vary therefore greatly with the judgment and discretion of the forester, as he has to adapt the treatment of the forest to the circumstances of the case.

Natural reproduction seems to require especial care on southerly and westerly slopes, where the sun has greater power, and dries up the surface of the soil much sooner, and lets the weeds grow much faster, if clearances are made to the same extent as on level ground, or on northerly and easterly exposures.

I had several opportunities of witnessing cases where, on southerly slopes, year after year new attempts were made to stock the hill sides with beeches without succeeding, and at last the spruce, or even Scotch fir, had to be resorted to instead of the beech to make use of the ground.

The third felling is called cutting for light (lichtschlag), as its chief purpose is to admit light and air in greater abundance as the young trees require it. The cutting for light.

This is generally commenced when the seedlings are two years old. It is also regulated very much by circumstances, and whilst in the one case the parent trees may be required longer on account of the spring frosts, so injurious to the young beech, in others their early removal is necessary, even if an increase in size be sacrificed, for the establishment and vigorous growth of the young trees.

Neither do partial failures prevent the removal of the old trees, but are adjusted at once by sowing or planting as the safest and most expeditious mode of securing the establishment of the young forest.

After the third or light-felling follows the gradual removal of the old trees, or final clearing, which is regulated in the first instance also by the requirements of the young trees, and after this by the fixed yearly out-turn, as laid down in the working plan, and other circumstances. Final clearing.

As a general rule all these fellings are carried out gradually without causing sudden changes in the forests.

The aiding of natural reproduction is either accomplished by sowing, if failures are perceptible at the early stages of it, such as insufficient germination of the seed, or early dying of the seedlings, or by planting, if the seedlings get destroyed later by spring frosts, or are choked by weeds. Aiding of natural reproduction.

The sowing is carried out in the forest on strips two feet wide, in furrows, or on patches 2–3 feet square, prepared by hoeing for the purpose, and by loosening and levelling of the soil, whilst planting is done with seedlings 2–3 feet in height, taken from adjoining nursery beds, or from spots in the forest where there are more than are necessary.

It is evident that if with all this great care and attention to aid natural reproduction, still occasional failures occur, how much more unreasonable it is to expect forests in India

to keep in an equally rich and thriving condition, if left to themselves, or worked only with a view of extracting the timber from them.

Pure high forests of beech.

No mode of growing the beech suits it better than in high pure forests, it liking the deep shade and coolness of the soil, which its dense foliage secures for it, and improving the soil more than any other forest tree, by the abundance of leaves shed every autumn, forming a rich vegetable mould, and facilitating the decomposition of the mineral and vegetable substances in it.

Such forests are allowed to grow in a rotation of 80–120 years before the regeneration or final clearing is carried out whilst all thinnings previous to this, are considered as the result of measures for the improvement of the forest, the object in undertaking them being to improve the condition of the remaining trees.

The general rule is to repeat thinnings often, and to remove little at a time.

"*Conservations-hieb*" introduced by Forstmeister Seebach in the Solling forests.

I had also an opportunity of seeing a modified form of beech high forest, in which at an age of about 60 years, a large number of the trees were felled and removed, whilst the new covering of the soil for the benefit of those left standing was accomplished by again sowing beech underwood amongst them which had much improved the old trees left, and resulted in a proportionately rapid increase in size.

The beech in coppice woods.

In coppice woods it occasionally happens that the beech is allowed to remain if it comes up, but otherwise it is not much adapted for this mode of growing wood.

The beech in middle forests.

In middle forests or coppice under standards it is frequently spared by the woodcutter, although not so well suited for high trees in such a combination, as the oak, and other trees which give less shade.

Danger to beech forests from spring frosts.

The greatest danger that beech trees, especially when young, are exposed to, are the late spring frosts, which do great damage, and can scarcely be obviated.

They do most damage in valleys, or other low places, the neighbourhood of water, etc., where there is no current of air.

Danger from sudden exposure to sun.

Another enemy is the sun, which, if beech stems are suddenly exposed to its glare, damages and destroys them rapidly, as I had an opportunity of witnessing, although the trees were about 50 years old.

Other trees in the beech forests.

Not unfrequently trees whose timber is of greater value than that of the beech are scattered in the beech forest, to derive the benefit from the rich vegetable mould formed by the beech, but care is taken, that such trees, when placed

amongst the beeches are sufficiently advanced as not to get choked by the latter.

The trees thus employed are chiefly oak, ash, maple, larch and Scotch fir.

The beech in other forests.

I saw a remarkable instance at Rothenkirchen where beech had been planted under oak of about 120–150 years old, standing on old grazing grounds on which the villagers had been entitled to graze their cattle, and to various other privileges.

After it had been freed from these burdens by the villagers receiving other land, the oaks were stagheaded and altogether deteriorating, when beeches were sown and planted underneath, and these so benefitted the oaks, that they had made new vigorous shoots and become covered with leaves again and were now with the beeches under them in a condition to grow for as many years again as they had done already.

Management of middle forests.

In the Solling hills I had also frequent opportunities of seeing the management of middle forests being coppice under standards.

This mode of growing is here principally adopted by villagers and other communities, who by means of the short rotation of the coppice keep themselves supplied with firewood, whilst the high timber trees have to furnish the wood required for building and other purposes.

Middle forest demands good and deep soil, rich mineral soils being specially suitable, for the improvement, though the wood growing on it is limited, on account of the short rotation at which the underwood is grown, and the comparatively small number of older trees.

Kinds suitable for high timber trees in the middle forest.

The kinds most suitable for high timber trees are those which give the least shade and keep off as little of the dew and rain from the underwood as possible, whilst at the same time they are regulated by the requirements of those who own them.

Generally the better kinds of timber trees are chosen, conifers are not excluded, although of no use as coppice wood.

The kinds used in most cases are oak, hornbeam, maple, ash, birch, and an occasional beech.

Kinds suitable for coppice wood in the middle forest.

As coppice wood, those kinds are most suited which shoot out again easily from the root stock, and stand the shade from above best, as for instance, the hornbeam, maple, beech, oak, birch, and so forth.

The rotation of the latter is generally 30 years, but varies according to soil and locality.

Since underwood and timber trees have to be felled at

the same time the rotation of the latter has to correspond with that of the former, and is either three, four, or five times that of the coppice, so that the timber trees are felled at 90, 120, or even 150 years, or some at each.

Reproduction of middle forest.

At each felling a number of young saplings are saved to replace those timber trees, which are being felled, and as a rule only seedlings are chosen, so that there are timber trees of 30, 60, 90, and 120 years after each felling, if it is intended to grow as large timber as requires 150 years to grow.

Foresters distinguish them by different names according to their age.

The greater the number of timber trees kept, the less can be expected from the coppice wood, and vice versâ, so that the desired crop has to regulate the proportion to each other.

Since every time the coppice is cleared away the ground is laid open to a great extent to the sun and the weather, and but few dry leaves are added for the improvement of the soil, the latter deteriorates very rapidly, if not rich, and it was noticed that foresters as a rule kept rather more timber trees in these forests than the theory admitted, and even in many places endeavoured to induce the communities to take to high forests altogether, which although perhaps not so convenient, still gives a larger return, and keeps the soil in better condition.

The natural reproduction takes place by the shedding of seed from the old trees, and there is usually no lack of seed in such forests, since by the free access of air and light, the bearing of the trees is much facilitated.

By these seedlings, those stocks which die out, get replaced as well.

Where natural reproduction fails sowing and planting is resorted to and is safer in good sized clumps than singly, and where branches cover the lower part of the timber trees they are trimmed off, so as not to interfere with the underwood.

It had been the rule in the communal forests in former times, that any oak which might grow should belong to the state, in consequence of which oaks had become scarce in these forests.

Importance of roads.

The forests on the Solling hills had greatly increased in importance and value in late years by the construction of roads, rendering them more accessible, where the wood had to be carted up hill, a gradient of 8 feet in 100 was not exceeded.

Timber transport, especially that of heavy logs, was managed by means of pulleys, which might with great advantage be brought into more general use in India. Timber transport.

A remarkable instance of privileges enjoyed by villagers, having almost overgrown the quantity produced by the forests, came here to my notice. A remarkable privilege.

The potters of Fredelsloh, a village on the Solling hills, had made the Duke of Grubenhagen, when in camp with his men near their village during winter, very comfortable, by taking all the stoves they had in store up to the camp, and putting them up.

The Duke in return felt grateful, and promised a supply of wood from his forests for burning their tiles and pots, &c. free of charge.

As time went on these potters prospered and multiplied, until at last the forest, although very extensive, could hardly supply what they asked for, when their claims had to be defined as to the number of families entitled to receive wood, and the quantity for each. Since this settlement the forest is beginning to recover.

Of the various methods of planting employed here, there is one which does not seem very judicious at first sight, but has been so remarkably successful that it is worth describing. Planting with an iron spade.

The planting is done with a small spade of solid iron, about 18–20 pounds in weight, the handle of which is 3′ 4″ in length, and strongest immediately above the blade, which latter, slightly wedge-shaped, is 13½″ long and 6¾″ across at its broadest and 4¾″ at its narrowest part (Fig. 2).

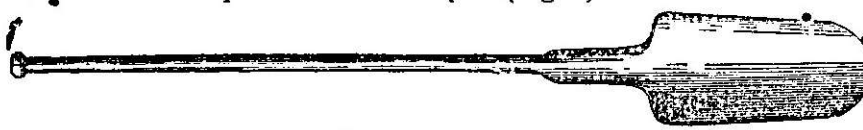

Fig. 2.

This spade is driven into the ground on the spot where the plant is to stand, and not quite perpendicular.

The hole thus made with this spade is slightly widened by bending the spade a little to all sides, after which it is drawn out.

The plant, 3–4 years old, of beech, spruce, oak, &c., is dipped with its roots into a thin mixture of loam and water, which adheres easily. In this state it is pushed with its roots into the hole as far as possible, and with continual shaking, by which the roots get straight down into the hole, drawn up to the level at which the plant is to stand.

Here it is held firmly by one man, whilst another drives in the spade a second time, about three inches from the first hole and parallel with it, and first presses with its point towards the first hole, and afterwards with the broader portion of the blade, by which process the plant gets very firmly pressed into the soil.

If necessary the spade is driven in a third time to close up the second hole slightly.

After this the soil is beaten firm all round with a wooden mallet towards the plant, but these blows should not be dealt closer than three inches from the plant.

This planting was carried out without previous clearing or preparing of the soil, and even answers well in stony and rocky soil, as the spade penetrates easily on account of its weight.

Spruce forests on the Harz mountains.

On the Harz mountains I acquired chiefly a knowledge in the management of spruce forests at the following localities in succession :

Westerhof.	Herzberg.
Grund.	Lauterberg.
Osterode.	Ilfeld.
Riefensbeek.	

Seed drying kiln.

At Westerhof, I went over the Government seed drying kiln, for getting the spruce seed out of the cones, and cleaning it of the wings, which is carried on here on an extensive scale, the spruce being plentiful, of excellent growth, and producing exceptionally good seed.

The cones are collected by contract work, and the payment varies according to the seasons, if plentiful or otherwise, and generally enables the workman to earn from 2*s.* to 3*s.* a day.

After all the Government stores are filled, private persons are allowed licenses to collect, for which each person has to pay 1*s.* a season.

In the cones the seed remains good for seven to eight years.

When the kiln is being worked, about 60 bushels of cones are dried out in a day, of which each bushel gives about 1·2 pounds of clean seed, without the wings on the seed.

The Government kiln turns out about 180 cwts. of clean seed yearly, whilst private parties in good seasons have turned out as much as 1,600 cwts. besides.

The cones, when first brought in, are stored in large rooms with perforated walls, so as to admit a free current of air through them.

The kiln itself consists of three rooms, the centre one of which is heated by means of a large oven, from which large iron pipes, about 6″ in diameter, are passed twice through the room before they lead into the chimney.

This room is separated by walls, in which there are holes 9″ from the two outer rooms, in which the cones are being dried.

By means of these holes which can be closed at pleasure, the temperature in the drying rooms is regulated, and kept between 122° and 128° Fahr.

The drying is done in large wire drums, out of which the seed falls on to the floor of the room.

The drums are made so that they can be turned from the outside of the drying room, where it is cooler.

Each of the drying rooms contains 12 drums.

These drums were first filled in the evening, and the temperature got up to about 128° Fahr., and left so for the night. The next morning when some of the seed had fallen out, the fire was lighted afresh and the temperature got up again to the same heat, the drums being turned every half hour, in consequence of which the seed dropped out, and left the cones empty by night.

One half of these empty cones are required for firing the kiln, whilst the other half are sold as fuel.

The cost of the cleared seed is about 3*d.* per pound to Government, at which rate the seed is distributed, whilst the seed not required by Government is sold to the public at the rate of 4¾*d.* per pound.

Spruce on the mountains.

Although the spruce is frequently seen in the plains and on some of the hilly parts of the Province of Hanover, its head quarters are the Harz Mountains, where it does well up to an elevation of 2,500 feet above the sea.

Use of the spruce wood.

Its wood is chiefly used for building purposes, and the larger logs sawn up into planking by the saw mills, besides which there are several wood grinding mills in the Harz, which grind the spruce wood into pulp for paper manufacture, and one mill I visited in which the saw dust from the saw mills was ground down further into wood flour, or dust for paper manufacture.

At the latter establishment saw dust from the saw mills was purchased at the rate of 4¾*d.* the cwt., and it was sold afterwards according to quality.

	s.	*d.*	
No. 1. - -	2	6	per cwt.
No. 2. - -	1	6	do.
No. 3. - -	0	9	do.

It is packed in bales, containing about 2 cwt., and measuring 18 cubic feet, or in bags of 1 cwt.

In India, where there is a large consumption of paper, and thousands of square miles are covered with forest trees, producing soft white woods, a similar application of it might be advisable.

Natural reproduction of spruce.

Natural reproduction in the spruce forests on the Harz is seldom attempted, as being too slow and uncertain, but if there are large clumps of naturally sown spruce, they are sometimes kept up.

Raising spruce forests by sowing and planting.

Almost all spruce forests are regulated high forests, with complete clearings, either re-sown, which is still preferred by some, or planted, which is by far the most general mode of establishing or re-establishing spruce Forests.

If sown, lines about two feet in width are prepared by clearing the weeds, &c. off the ground, and placing this at the edge of the lines to prevent the wind blowing away the seed, or rain washing them off.

The soil on these strips is sometimes loosened, or left as it is if the seed is to be sown broad-cast. If the seed is sown in rows small furrows are made.

Between the cleared strips, the ground to double this width remains untouched.

On the hills these strips are always run horizontally along the hill side.

In other cases, only small patches are prepared for sowing, and this is the practice in high and much exposed localities.

For plantations, the seed is sown in seed beds (*Samen-kämpe*) which are good, even, and sheltered pieces of land about half an acre in size and well dug up, afterwards levelled, and occasionally also slightly manured by ashes of the weeds, remains of wood, &c., collected on the surface, brought together, burned, and afterwards mixed with the soil.

These seed beds are usually in the immediate neighbourhood of the ground to be planted and have to be fenced in.

If the seedlings after they are three or four years old are to be removed from here at once to the spot where they are to remain, the seed beds have to be larger, especially if the young plants are to be planted out in numbers, *i.e.*, three or four plants in one hole.

In the latter case the seed is sown generally in furrows, one foot apart, as being more convenient, and requiring

here in the hills about 75 pounds of seed for half an acre, which is sufficient to plant 50 acres of forest.

The better plan, however, is to have the plants from seed beds, after they are two years old, transplanted singly into a nursery at about seven inches distance, where they remain until they are four or five years old, this however requires at least as much space again for the nursery as the seed camp.

Not unfrequently four to six years old seedlings are taken from adjoining forests where they are generally so close as to permit of the removal of many of them, and this is the most inexpensive way of procuring seedlings in limited numbers.

Where there is a great demand for the thinnings of young spruce forests, as well as in high and exposed localities, the planting of three or four seedlings in one hole recommends itself.

If it is likely that the ground gets run over rapidly with weeds or the soil being dried up much by the sun, the replanting of the ground is done as soon after the removal of the old forest as possible, whilst in localities where the danger from insects, especially from the small beetle, (*Curculio pini*) is great, it is preferred to let the ground lie over for two or three years before planting.

Planting is done in autumn as well as in spring, but the latter is preferred.

In these hills the spring planting commences at the foot of the hill and progresses up hill, as the weather improves.

Autumn planting, which becomes necessary on account of short spring time, begins in the end of August, from above, and continues until the end of September at the latest.

Spruce is usually planted 4–5 feet apart and in many different ways, whichever suits the one or other locality best.

On the Bruchberg, about 2,600 feet elevation, I saw very successful and instructive cultivation of spruce on the High Moors. **Cultivation of spruce on the high moors.**

They were, in the first instance, well drained by a network of ditches, and afterwards the plants placed, not in the soil, but on the top of it, on small mounds of earth prepared on the spot, and the roots surrounded with the same, and afterwards the mound covered in with a few sods of turf.

This operation was expensive and not expected to repay itself during the first rotation, but the whole area was not

only redeemed again for cultivation by it, but the spreading of the moor was prevented.

As the spruce has no deep going taproot, but spreads her roots more along the surface, the cool and damp surface soil of the mountain suits it particularly well.

Under moderate shade, such as for instance the oak and Scotch fir afford, it also thrives well, but its own foliage is so dense that nothing else can be grown under it. It thrives however remarkably well in company of the beech, and then produces exceptionally fine and large timber.

Danger the spruce is exposed to from snow.

At the higher elevations, the spruce is frequently broken down by accumulated snow, especially the young and regulated forests, and there are no means of preventing it except by going back to the old irregular mode of management.

From wind.

Another great danger the spruce is exposed to on account of her roots only spreading in the surface, and for want of a strong taproot, are the storms which had in December 1868 overthrown in some localities trees amounting to seven times the yearly quantum of wood fixed for felling.

This renders great care necessary in deciding the direction in which the felling operations should progress.

From insects.

To protect the spruce forests against damages from insects, the forester has to be constantly on the alert, as they are many and, if not checked in time, great damage is done by them.

The most destructive kind noticed was the ordinary spruce bark beetle (*Bostrichus typographus*) which attacks the bark of living trees, and had in some of the localities visited by me destroyed so many trees that, after the diseased trees had been removed, the forest had become so open that the wind would soon have overthrown the rest if they had not been felled.

Experienced men are told off to guard against this danger, by going through the forest to search for the trees attacked by the beetles, and to fell and bark them, so as to prevent the spreading of the insects, and it is considered they are quite master over them.

They generally attack trees loosened in their roots by wind, and they are easily known after the beetle gets into them by their foliage turning yellow.

In spring, when they are most destructive, healthy living trees are felled at the southern margin of the forests, in sunny spots for the purpose of attracting the beetles.

Such trees are frequently full of them within 3–4 days after having been felled.

The trees attacked by the beetle are barked, whereby the larvæ are destroyed if not already too far advanced; where the latter is the case the bark is collected and burned.

To prevent any of the beetles escaping at the barking of the stem, a cloth is commonly spread under the stem with great advantage.

Another beetle (*Pissodes hercyniæ*) has done great damage in young forests on the Harz mountains, and has to be watched very closely and the trees attacked removed at once.

The timber beetle (*Bostrichus lineatus*) which attacks newly felled trees and penetrates deep into the wood, is also common in the Harz forests, and has to be watched closely.

For the young plantations of spruce the beetle (*Curculio pini*) already mentioned, is the most destructive, as it attacks the young newly planted trees very readily, eats off the bark immediately above the root, and thus kills them.

They are caught under fresh pieces of bark about one foot square, which are distributed over the ground and put with the inner side downwards either before the planting is commenced, or amongst the young trees after it has been completed.

These pieces have to be looked over daily and the beetles collected.

The bark of the spruce is also frequently gnawed off by the deer, and places so affected scraped afterwards by men who collect resin. From deer.

The latter is prohibited, but in one of the places visited, 100 cwts. were seized the winter before last.

Except in very young and too thickly sown or planted forests, or where other soft wood has sprung up, much thinning out is not required with the spruce, and only those stems should be removed which have got suppressed by the stronger plants. General management of the spruce.

According to the different altitudes and localities, if more or less suited for it, and the size of the timber most saleable, the length of rotation with the spruce varies from 80–120 years.

Whilst the felling and removal of the timber is done one year, the digging up of the rootstocks for charcoal burning is carried on the next, which latter is also an important measure for the succeeding cultivation of the ground.

Of those trees which grow best with the spruce, the silver fir and the beech are the two most important.

Larch, which formerly was often planted with spruce, has lost much of its importance as a forest tree, on account of its deterioration in this part of Germany.

Charcoal manufacture.

Under former arrangements, great quantities of wood were made into charcoal for the Government silver and iron mines, but when the latter were required to credit the forests with the real value of such charcoal, they soon made other more economic arrangements, and the result has been that coal is now wisely burnt by this establishment.

Roads.

Owing to the extensive manufacture of charcoal, roads for the carriage of timber were less necessary on the Harz than elsewhere, and this circumstance still places some of the Harz forests at a disadvantage.

In the construction of such roads at present, the gradient varies between 3 and 6 feet in 100.

SILVER FIR AND SPRUCE FORESTS OF THE BLACK FOREST.

Black forest mountains.

As suggested in the memorandum for the guidance of forest officers, I visited the Black Forest mountains with a view of seeing the management of the silver fir forests on those mountains and the transport of timber as far as such could be of use to me in India hereafter.

For this purpose I went to the Forst revier Rippoldsau, the adjoining districts of the State forests of the Grand-Duchy of Baden, and the Freudenstadt forests in the kingdom of Würtemberg.

On my return from there to Hanover the forests on the Hauptsmoor, near Bamberg, in Bavaria, where the natural reproduction of the Scotch fir is managed very successfully, were also visited.

The silver-fir forests.

The Black Forest mountains are one of the homes of the silver fir, the forests of which, near Rippoldsau, are situated beween 2,000 and 3,000 feet, and therefore at an average height of 2,600 feet above the sea.

The winters are severe, with an average depth of three and a half feet of snow in the valleys from December until March, whilst on the hills the average depth of snow is five to eight feet from the beginning of November until the middle of April.

Management.

They are partly regulated forests, in which, however, a gradual felling for the natural reproduction of them is carried on over one-fourth or one-third of the whole area at once,

from which every year during a period of 30 or 40 years the largest trees are removed, whilst the rest are allowed to grow to a larger size during the remaining years.

This is done, as the price these large trees fetch is much higher in proportion than that of smaller ones, and all are felled and removed in one piece if possible.

Natural reproduction is chiefly resorted to in these forests, which, in consequence of the young plants growing well in the shade of the old trees, is very easily accomplished, even though it is extended over such a long period as 30 or 40 years. Natural reproduction.

To be able to keep as many trees as possible growing on the lands on which the regeneration of the forest is going on the branches up to one-third or two-thirds of the height of the tree are sawn off to admit air and light for the young plants, which does no harm to the silver fir, but on the contrary is said to aid the more rapid increase of the trunk, whilst the branches are used for litter.

This sawing off of the branches is commenced from above by men who climb up the trees, and who earn from 1*s.* 4*d.* to 2*s.* a day.

Regular seed-bearing seasons occur at longer or shorter intervals, but nearly every year there is sufficient seed to increase the number of young plants where it is wanted.

Moss cover is very favourable for the germination of the seed, whilst such places which get covered with grass or weeds, or where for other reasons the seed does not germinate freely the soil is at once prepared by clearing and slightly loosening it in strips or patches for the reception of the seed, the germination of which is thus facilitated. Aiding of natural reproduction.

If the open space in the forest is so large that the seed from the old trees does not reach the whole of it, sowing by hand is resorted to early, so as to let the young plants be as nearly as possible of the same age.

If by the time the old trees are nearly all removed there are still some parts not yet covered with young trees, planting is resorted to.

For the better growth of such planted trees the existing groups are somewhat rounded off to avoid the young trees planted having to struggle with the others, perhaps already 20 to 30 years old, and where on incompletely stocked spaces, which have to be filled up by planting, there are single trees of some 20 to 30 years, they are cut down altogether; or, if they are standing in numbers and are not quite so large some of the lower branches are lopped off the outer ones, so as not to interfere with those planted.

These plants are either taken from nurseries or out of the forest if the latter have not grown in too deep shade, which would render them liable to suffer on being removed into open places.

Collecting of seed and nursery management.

The seed is collected with some risk from the trees in October, before the cones open and it falls out.

As the seeds are very oily they are best kept in the cones or sown at once. The sowing is done on prepared beds in rows four inches apart, and after germination the ground is covered with moss to keep the moisture in the ground.

The seedlings one year old are transplanted into rows six or seven inches apart and three inches between the plants in the rows, after which the soil between them is also covered with moss.

Here they have to remain for two or three years before they are fit for transplanting.

Shade from the side is very beneficial for the seed beds as well as for the nursery.

Plants from the nursery are preferable to those out of the forest, and the latter, when used, are as a rule removed with some of the soil adhering to the roots.

Planting.

Planting is better done in spring than in autumn, and in the usual way, the roots of the young plants being cut as may be necessary.

They have to be sheltered as far as possible against sun, dryness, or spring frosts, and the plants as a rule thrive better on the cool northerly and easterly slopes of the mountains than anywhere else.

The silver fir grows very slowly at first, and does not get much higher than six inches within the first four or five years.

At the age of 25 years it begins to grow very fast, and increases most between the age of 80 and 120 years.

It likes best a deep, cool, moist, and loamy soil, with a covering of moss on it, and sends its roots deeper than the spruce, in consequence of which it suffers less from the wind and storms than the latter.

Other trees with the silver fir.

On southern slopes of the mountains it sometimes fails, or only partly succeeds, and then Scotch fir is planted to fill up the space. The latter grows in such localities here in the mountains very luxuriantly and to a great size.

A number of spruce are sprinkled through the forest nearly everywhere, and are generally employed when natural reproduction has to be supplemented by planting.

Fellings.

Fellings are conducted from an easterly direction towards the west, as the prevailing winds come from the latter direction.

Thinnings generally become necessary about the thirtieth year, after which they have to be repeated every tenth year until the gradual felling of the largest trees commences.

These fellings are regulated by the requirements of the young seedlings, and carried out very gradually and only sufficient to admit as much light as is absolutely necessary for the young plants, leaving as many of the old trees to grow as large as they can.

It also happens that some of the best trees are left standing or are held over for the next rotation to obtain exceptionally large timber.

This can however only be done in somewhat sheltered positions, and on rocky ground, where the storms are less liable to overthrow them.

Some damage is always done to the young plants by the removal of the old trees, but the silver fir seems to repair them almost faster than any other coniferous tree.

Use of the wood.

It is also remarkable for its high and more cylindrical stem than other conifers, and the comparatively large amount of timber it produces, which is much used for masts in ships, axletrees of windmills, buildings, and other purposes; and although it is admitted to be somewhat inferior to spruce, it fetches in the Black Forest mountains the same price as spruce.

The long and barked logs of conifers here are valued according to their length and their diameter at the smaller end.

Transport of wood.

Whilst small wood is moved on sledges in winter, timber is transported either by dragging with horses, let down the hill side by means of ropes, sent down timber slips, and floated on the mountain streams, all of which methods are very instructive, and it is hoped will prove of use to me in India, where I have felt the want of it already, previous to this.

Dragging by horses.

The dragging by horses is simple; it is done on comparatively level ground, by means of a rope fastened to a wedge (Fig. 3) driven into the end of the logs, and needs no further description.

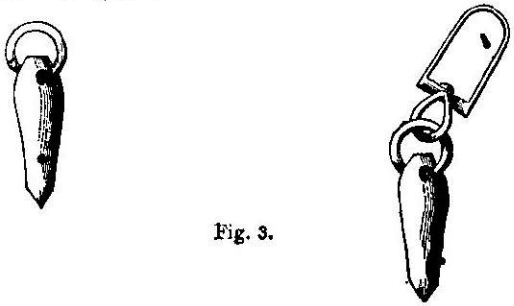

Fig. 3.

The wedge used is 6 inches long oy 1½ inches broad, whilst the ring is about 2½–3 inches in diameter.

Lowering by ropes.

The lowering of logs by ropes is employed for letting them down steep hill sides, and is sometimes connected with danger to life and limb to those who have to carry it out if they lose control over the rope on the descending log.

The rope in this, as in the previous case, is either fastened on to the log by means of the wedge already mentioned, or, if the log is too heavy, by means of a very strong and peculiarly shaped hook (Fig. 4), which is sufficient for the heaviest and largest timber.

This hook is 18 inches long, and the ring attached to it about 6 inches in diameter.

To be able to regulate the rate at which the log travels, and to have the power of checking it when required, the rope is wound several times round a tree or strong post before the log is started.

Fig. 4.

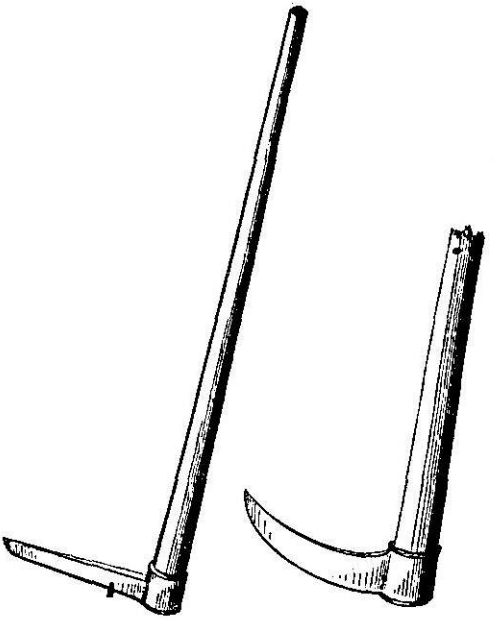

Fig. 5.

For the setting in motion or otherwise moving these long and heavy logs the men use a kind of pick (Fig. 5), which

by its strong and long handle gives them great power of leverage, when the point is placed under the log and the handle drawn towards them.

The wooden handle of this pick is 4–4½ feet long, and at the thinnest end 1–2 inches thick. The iron is about 13 to 14 inches long, 1½ inches broad, and ½ inch thick; the head of it being 2½ inches high by 2 inches broad.

The timber slips are constructed very simply, but are for all that very efficient for the transport of the timber out of the hills to a point where the streams can be used for floating timber. Timber slips.

They are simple bridle paths cut out of the hill side, and winding around them with a gradient varying between 2 and 40 feet in 100, according to circumstances.

So, for instance, on such slips as are used in winter, when snow and ice cover them, 2–3 feet in a hundred is found sufficient for the timber to travel quickly and safely down on them, whilst for smaller wood with such a gradient it becomes necessary to place wood at intervals in the ground across the slip, as railway sleepers are put across a railway line, to give more impetus to it.

Ordinarily slips have a gradient of 10 feet, whilst the steepest have one of 35–40 feet in 100, which latter can only be used, however, in very dry weather, and dare not be exceeded; but the lowering of the logs by ropes must be resorted to if steeper descents are to be got over.

If the momentum of the travelling log is to be lessened this is sometimes effected by throwing dry earth, charcoal dust, and in winter even loose snow, on the slip, which, however, only answers for a short time, and has to be repeated.

Sudden and great changes in the gradient are provided for in the case of an increase, which might cause the logs to shoot off the slip, by a covering in of the slip at such points as far as the change extends.

In the case of a decrease, which might stop, damage, or also cause the logs to bound off the slip, the change is made more gradual through building up such points by laying logs crossways over each other, and laying a floor of the slip out of logs. Where such a floor of the slip made of logs placed close alongside of each other is required further than the length of one log, they have to be placed, as a matter of course, so as to let the upper ones overlap the lower, or to rest with their lower end against the upper end of the fol-

lowing log, so as not to have any projection against which the logs might strike in their descent.

In the case of having to cross a public road which must not be closed, on the upper or higher side of the road the slip is built up close to the road, and in the same way as those places in which the gradient suddenly decreases, to a height of six feet or more, according to the width of the road, so as to enable the log to shoot across it through the air on to the lower continuation of the slip (Fig. 6).

This construction has also to be resorted to where such a road leads along the bottom of a valley and there is not sufficient space between the road and the hill side for either storing the timber, or letting it run out, on the same side of the road.

To keep the logs on the slip in their descent, one or more logs are placed on the outer or on both sides of it, leaving a space of 3–4 feet between the sides, for the timber to travel on.

These logs on the sides are fastened firmly into the ground with wooden stakes 4–5 inches in diameter, and 4–5 feet in length, of which one is driven through the so-called shear (Fig. 7) at the end of the log, keeping it from slipping further down the hill, whilst others are driven in outside of it, to keep it from being pushed back or away from the slip, whilst it is kept from falling forward or on to the slip by the next log above overlapping it (Fig. 8).

Great curves in the slip are avoided as much as possible, but where, in consequence of such, the outer side of the curve is subjected to greater wear through the concussion of the logs against it, there are in the first instance 2 or 3 laid above each other (Fig. 9), as well as being made to overlap to a greater length, viz., 20 to 30 feet, than is necessary where the slip is comparatively straight.

In the latter case, the placing of the logs against each other is often sufficient, but then, the thickest end of the log is always placed down the hill, and a shear is cut into the upper end of the log as well as into the lower one.

To place several logs above each other, holes are made through the ends, and stakes 3–4 inches in diameter driven through, and where the concussion from the descending logs is very great, another log, earth or snow are added to the stakes, driven in as support of the sides.

Junctions of slips coming from different sides of a hill must always be strengthened by overlapping to a greater extent, and by placing several logs above each other.

Fig. 6.

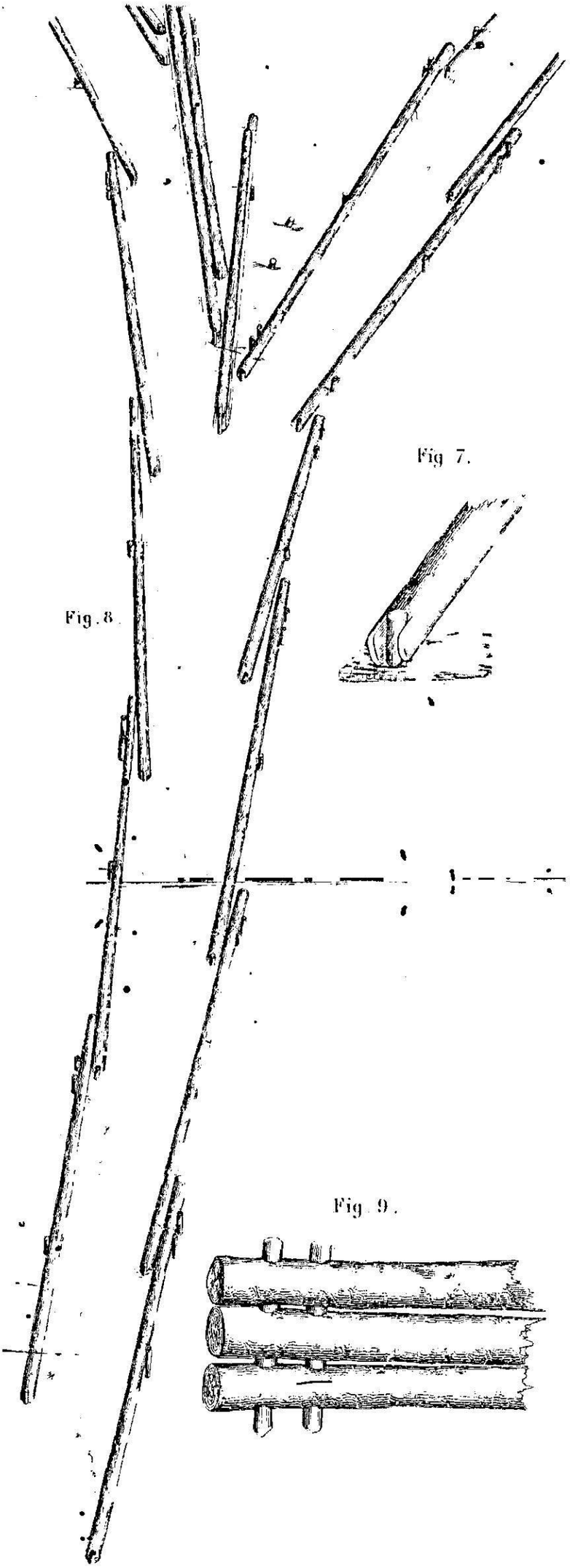
Fig. 7.
Fig. 8.
Fig. 9.

The logs used for the sides of the slips are part of the timber to be removed, and the building of a slip consequently always commences above, where the timber lies.

Logs are sent down the slip with the thick or thin end first, whichever is most convenient, with the thin end down the wood travels faster, but those required for the building of it are sent with the thick end foremost, if it can be done without much labour, and the ends which are sent down foremost are always rounded off a little.

The breaking up of the slip is done after all the timber is down, and commences also from above, so as to use the rest of the slip for the removal of these logs also.

It follows from this that the greater the quantity of timber to be removed at one time, from one spot, the cheaper the transport.

Logs are never started from above until the arrival of the preceding log, and the slip being clear below, is announced from there by the blowing of a horn, to those above, as the descending logs travel with such a force and rapidity, that they would destroy everything which offered any resistance, and where the latter is sufficiently great, as would be the case if it dashed against another log lying on the slip, both would be shattered into pieces.

The logs are either made to run out on a horizontal or slightly ascending portion of the slip, or on an open plain, like the bottom of a valley, or against the opposite side of the hill.

Floating of timber.

Nearly all the timber thus brought down from the higher hills is transported further by floating. On the small mountain streams near Rippoldsau, in which there is but very little water, this can only be managed by constructing locks, which retain considerable quantities of water at certain points of the stream until required.

Water locks.

These locks are constructed by laying 4 long and thick logs right across the bottom of the stream, so that their ends extend into either bank for about 3–4 feet.

These logs are fastened together by stakes, as the logs are fastened together on the timber slips.

Into these logs strong square uprights are let in, which rest above against other long logs, generally four in number, which are placed across the stream about 8–10 feet above those at the bottom of it, having also to extend into either bank of the stream, and serve at the same time as a bridge across it.

Before the uprights strong timbers or planks are fastened

tightly, which have also to extend 3–4 feet into either bank of the stream.

Where the nature of the banks is such as not to afford sufficient support to the timbers, the latter has to be got up artificially, either by masonry or by forming a large framework out of logs, which is filled up with stones (Fig. 10).

In the centre of the lock one or two gates are provided for the passage of the rafts by having two or three of the uprights provided with mortices, into which square pieces of timber are laid, tenon like, and are kept into their places by the pressure of the water, thus closing the gate.

In one of the uprights the mortices have to be open on the side looking up stream and twice as deep as the closed mortice in the other post, so as to allow the timbers to be pushed out of the closed mortice.

By means of this arrangement the timbers closing the gate or gates are easily removed with a strong crowbar, or a beam, and with these or a boat hook hauled into the sides.

Where the volume of water is very great sluices are also constructed at the side of the gate so as to expedite the letting off of the water.

The gates and sluices are usually thrown open one to two hours before the raft arrives so that not more than two and a half to three feet of water is left in them for the passage of the raft which travelling on water supplied by locks above, soon overtakes this water also, as it travels faster than the latter, and has to be checked and even sometimes stopped to let the water get ahead of it again.

For the lifting or raising of the raft, three spars are fixed slanting through the raft, and well secured with ropes or withs.

They are made 10 to 12 feet long and chosen from the butt end of Scotch fir, if procurable.

In the case of stoppage of the raft being caused by one of them it is quickly loosened by the cutting of the ropes or withs with which it is tied, and if the spar breaks, spare ones are carried on the raft to replace it.

The latter are built at suitable places in the streams, where the timber is previously collected.

Floating is carried on during March, April, and May, but chiefly in April.

The size of the raft varies, as a matter of course, according to the size of the stream, and whilst on the smaller ones three or four men are placed to guide them, on the larger

ones, which are sometimes 16 feet broad and reach a length of 2,000 feet, 16 or 18 men are placed.

Wherever necessary logs are also placed on the sides of the stream or across the bottom of it so as to prevent the bed being washed out or very uneven, besides allowing also the rafts to pass over them much more evenly than over the rocks alone. Improvement of streams.

They are fastened by wooden spikes both vertically and horizontally.

IV.

On Plantations of Scotch Fir on Moorpan Soil. By George Ross, Forest Probationer. Dated May 1872.

Moorpan presents in the lowlands of the north of Germany, one of the most formidable obstacles towards the cultivation of the soil as forest land, with which the forester has to contend.

It occurs in the sandy low-lying countries, as a hard, sometimes solid and compact formation, often extending great distances without intermission.

It is either of a reddish black or of a yellow colour.

The depth at which the strata are found beneath the surface varies generally from one to two feet, but extends even to four feet.

The thickness of the strata varies from a half to 12 inches and even more, but is as a rule between three and six inches.

Moorpan is composed principally of sand (80 to 90%) which is firmly cemented by heather humus. It contains also a slight percentage of iron sesqui-oxide and of aluminium silicate, and there are also traces of phosphoric acid. These with the large percentage of sand already stated constitute its component parts.

The nature of the layer differs very widely, sometimes it is so hard that it is necessary to use the pickaxe to break through it, at other times the spade is sufficient, and if the stratum does not lie too deep the plough can often be employed with success.

After the moorpan has been brought to the surface and exposed to the influence of the weather particularly that of frost, it resolves itself into earth, sometimes within the space of a year, but when the layer is very hard and massive the process of "weathering" may last for several years. For instance, we saw in the forest of Nienburg, where the ground had been trenched, the moorpan still lying upon the surface quite "unweathered" after having withstood the atmospheric influence for three years, while in other places in the same forest, cultivated at the same time, the "weathering" had taken place so thoroughly that the presence of moorpan could only be detected by the brown colour of the sand.

Moorpan belongs to the present geological period, and is being formed, if the circumstances admit, to this day. In the neighbourhood of Nienburg there are great numbers of ancient tombs, which are often dug up in the process of cultivation, and the urns which are found in them are all encrusted with moorpan.

Moorpan is only to be found in a sandy soil where heather is growing or has grown and never in a loamy soil, even if heather has grown upon it for centuries.

Moorpan is found in the more elevated as well as in the lower situations of the plains, but principally in the former, where on account of the dryness of the soil the heather humus is even harsher than usual.

As a rule the moorpan is only to be found where the common heather (*Calluna vulgaris*) grows, but it also occurs in some places where the bog heather (*Erica Tetralix*) thrives.

Tracts from which the heather has been for a long time cleared, to be used as manure, have generally a thinner stratum of moorpan than those on which it has been allowed to grow unmolested.

As a rule a yellow coarse-grained sand lies underneath the moorpan, it is therefore easy to check the work done, as if the layer has been thoroughly broken through, this sand must appear.

In some places the moorpan occurs more broken and in patches and the woods growing upon such ground present in general a very fair growth and appearance as the roots find their way through the crevices and interstices. We had an opportunity to see such a wood in the Nienburg forest, and although the growth of the trees was good, the formation of the roots seen on some trees torn up by the wind, was very peculiar and had the appearance of a broom.

Forests standing upon really firm moorpan impenetrable for the roots, have, without exception, a perfectly distorted, crippled, and unhealthy appearance.

In districts where the moorpan is kept continually moist and soft through the influence of ground water, the deep searching roots of the Scotch fir are able to penetrate through the stratum and as we saw in a neighbouring forest, the trees growing on this sort of soil have such an increase and healthy appearance that it is almost impossible to believe that moorpan exists here. In such districts this degree of dampness must be carefully preserved, for experience has shown that in woods of this description when the soil has been drained, the increase of growth has almost imme-

diately ceased, and the trees have assumed an unhealthy appearance.

For all this it is a fact beyond doubt or dispute that wherever moorpan is found, however thin the stratum may be, it always presents an obstacle towards the rearing and growth of trees, and unless the soil has been properly prepared beforehand the sowing or planting the same may be regarded as more or less useless, especially as the sandy soil, under which alone moorpan is to be met with, is only adapted to the growth of the Scotch fir, whose deep penetrating tap-root is not capable of breaking through the stratum. With few exceptions only cripple and dwarf woods are to be met with on moorpan when the soil has not been properly prepared. Even in its youth the presence of moorpan can be immediately detected by the shrub-like and unhealthy appearance of the Scotch fir, its short terminal shoots, and by the thin and scanty growth of the leaves, which are also of a yellowish colour; such a wood is the favorite resort of the different species of *tortrix*, and soon falls a prey to their ravages.

In cases of this kind there is no choice left to the forester. He must either cut down the whole wood, trench the soil, and plant afresh, or else he must cut lines of about six feet in breadth and at from six to eight feet apart through the wood and trench the so-cleared strips. We saw an experiment of the latter method, which had been carried out three years ago. The remaining trees had, through the influence of the air, which had now free access, considerably recovered, their terminal shoots were at once longer and their leaves grew thicker and presented a more normal appearance. In course of time also the roots find their way to the trenches where they are enabled to go deeper down for nourishment.

In the low-lying countries where moorpan occurs it is of the greatest importance that the forester should examine the ground carefully and attentively, especially tracts of heather, before he cultivates; to do this he must let the ground be dug in different places to ascertain the thickness of the moorpan stratum and the depth at which it lies, in order from those data to determine what mode of cultivation should be adopted.

In the province of Hanover, where thousands of acres of heather wastes have been purchased by the Government in the last few years, it was especially necessary to examine the ground carefully, as the expensive nature of the cultivation of moorpan has, of course, a very material influence

on the value of the land. The average price of such land was from 24*s.* to 30*s.* per morgen,* varying according to the depth at which the moorpan lay and the thickness of the stratum.

With regard to the component parts of moorpan experience has shown that when "weathered," they exercise a very favourable influence on the growth of trees, and the moorpan should therefore never be removed from the cultivated tract. We saw two adjoining pieces of land, on one of which the moorpan had been left, and from the other removed. The growth of the Scotch fir was much better on the former. Moorpan is destructive to the growth of trees simply because their roots cannot pierce through it, and because it entirely hinders the beneficial influence of water between the upper and lower ground. It is especially prejudicial by long-continued drought, as the ground moisture is unable to pass through the stratum to the surface.

To the question if, after being once broken up, the moorpan is again formed there is no definite or decided experience to reply. It can be fairly supposed though, that if on a tract which has been once cultivated the heather is again allowed to grow unopposed moorpan will again be formed, but that, on the contrary, on tracts which are regularly planted and cultivated its formation cannot take place.

Sufficient has been said to show that it is absolutely necessary to break through the moorpan if planting is to be carried on with success.

The methods of cultivation differ widely and are dependent upon the depth at which the moorpan lies and the structure of the stratum.

Where the layer lies two feet or more deep it must be broken through with pick-axe and spade. This is the most costly method and entails an outlay of from 30*s.* to 3*l.*, according to the hardness and depth of the stratum, to trench a morgen, the trenches being the same width as the spaces between them; in reality, therefore, only half of the morgen is cultivated.

Should a still larger outlay be required it is very questionable if it is judicious to cultivate at all. Small wastes in the middle of a forest might justify such an outlay, and in such places even more than 3*l.* might be expended in order to make the forest compact.

The trenches are, as a rule, six feet broad and six feet apart. The manner of proceeding is the following:—After

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One Hanoverian morgen = 0·6477 of an English acre.

the trenches are marked out by means of a line, the workman throws the earth out of a part of the trench until the moorpan is also thrown up on the surface, then going backward, he fills the hole thus made with the earth won from the next part, and so on until the trench is finished. In this manner the surface earth is thrown in first and the moorpan on the surface. It is of the utmost importance to control this work carefully, as it is only given by the job, and the workmen are therefore apt not to break through the stratum thoroughly. As it is impossible, when extensive areas are under cultivation, to be constantly superintending the work, the trenched ground is afterwards examined with the so-called moorpan-searcher in order to see if there is any part of the stratum still underground. This instrument is a simple bar of iron five feet long and half an inch thick, sharpened at the point and furnished with a handle.

In places where the stratum lies deeper, and where the outlay incurred by this manner of trenching would bear no proper proportion to the receipts gained by the first felling, a different and less expensive method is used, called in German "*rabatten-cultur.*" The process is the following:—Ditches of from four to six feet breadth are dug at a distance of from 12 to 16 feet apart; the contents of the ditches are thrown upon and equally spread over the broad undug beds with the moorpan on the top. By this means the beds or *rabatten* are considerably raised, and the plants placed on them have therefore a deeper soil, the stagnation of the upper ground water is prevented, the atmosphere is enabled through the open ditches to act on the remaining moorpan, and thus cause it more or less to "weather," and the unfavourable influence of the formation on the growth of plants is greatly diminished.

In order to save expense experiments have also been made by means of turning up the ground in holes of four feet square, the squares four feet apart from one another, but it has been found that the trenches and rabatten are much superior, as the plants on them have more growing room, and as the luxuriant growth of the heather encroaching from four sides is apt to choke the plants growing on the squares. The cost of this method averages from 24*s.* to 30*s.* per morgen.

Sowing was formerly almost without exception the rule, with from four to five pounds of Scotch fir seed per morgen. Latterly planting is the only method in use, unless it is an object to grow at the same time material for planting elsewhere, and thus cover part of the expense of a nursery.

According to the experience gained in the Nienburg forest planting with strong healthy one-year old Scotch fir has had by far the most favourable result. Plantations made with plants older than one year, as well as those grown from seed, have not the same favourable growth. The one-year old plants are reared on deeply trenched seed beds manured with the humus of *Calluna vulgaris* and *Vaccinium Myrtillus*, which has been brought some years before into heaps and been constantly turned. In this manner, unless the weather is very unfavourable, healthy strong plants are reared. The six feet broad trenches are planted with three rows of Scoth fir, the distance between them in the rows being three feet. Care should be taken to plant the two side rows as near as possible to the untrenched space, in order to favour the closing of the plants as soon as possible over the whole area. As it is most desirable to bring about the closing of the plants as soon as possible a row of Scotch fir can also be planted down the middle of the untrenched space at a distance of from five to six feet of each other. Of course those plants cannot have the same growth as those on the trenched ground, but it is undeniable that they also profit from the cultivation, and that the closing of the wood is greatly furthered by them.

The cultivation of the spruce fir, the Weymouth and Austrian pine has also of late years been tried; all three have up to the present grown well, but whether they will continue to do so is a question for the future to answer. The Austrian and Weymouth pine require the least anxiety, and even if the spruce does not grow well it will still be very beneficial as a protection to the soil under the Scotch fir. The squares which have already been mentioned are planted with one-year old plants; four or five on a square.

Where the ground is free from roots &c., and not too uneven, and where the moorpan layer does not lie too deep, at the most 18 inches beneath the surface, the plough can be used with effect.

If the ground is covered with scrub or strong heather it must first be cleared.

We had a good opportunity of seeing this manner of cultivating in the Luneburg Heath, where it was being carried out on a large scale. Formerly a so-called underground plough was used, but as it sprang too easily over hard moorpan without raising it, it has of late years been superseded by the sowing plough.

The sowing plough has in front a small wheel which can be raised or depressed at pleasure according to the depth

of ground the plough is meant to turn up. The plough should be longer and narrower than usual when it is required to go very deep, as one of such a construction passes more readily through the moorpan. The coulter must be high, and swung in such a manner that both earth and moorpan are completely thrown up.

A vigilant supervision is very necessary, and it must be seen to that the yellowish coloured sand lies on the surface.

Two furrows must first be ploughed with the common agricultural plough, the sowing plough then enters and turns up the second furrow. A third is then ploughed with the common or fore plough followed by the sowing plough, and so on.

In order to save expense, strips eight feet in breadth at a distance of six feet from each other are as a rule ploughed.

When the moorpan does not lie deeper than 12 inches, a pair of horses is sufficient, and the expense is about 27*s*. pro morgen; if the stratum occurs at a depth of from 14 to 18 inches six horses are necessary, and the cost is about 54*s*. pro morgen.

18 inches is the maximum depth at which the layer may lie if the ploughing is to be done effectually.

Ploughing is only done by the job.

The ploughs are furnished by the Forest Department, but the contractor is responsible for repairs and the cost of transport.

When the ground has been sufficiently exposed to the atmosphere the sowing or planting is carried out in a manner similar to that already described.

V.

An Account of the Laws and Regulations relating to the Management of Village and Ecclesiastical Forests in the Province of Hanover. By George Ross, Forest Probationer. Dated May 1872.

More than a century ago certain laws were made for regulating the management of the village, church, &c. forests in the former Kingdom of Hanover.

They were faulty, and the object to effect a decided change for the better was not attained, but in the year 1815 certain laws were passed for the forests of villages, churches, and public institutions in the principality of Hildesheim, by which a regulated and lasting economy was ensured.

The beneficial effects of these laws soon became apparent, and it was considered desirable to adopt a similar code for the forests of other municipalities as their unscientific management and administration gave great cause to fear that they would become more and more waste and barren.

In consequence of these circumstances, and in the interest of the public welfare, a law was passed in the year 1859, with the acquiescence of the principality of Calenberg-Grubenhagen, similar to that one which had been in force in Hildesheim since 1815.

By this law it was enacted that certain restrictions should be put upon the rights of the proprietors of the village, church, &c. forests in the principalities of Calenberg-Grubenhagen, and Göttingen, together with all lands belonging to them, and that the forests should be managed and governed according to the following regulations, as the indiscriminate and prodigal use of such rights had endangered the forests to the injury both of the heirs of the proprietors and the community at large.

The principal provisions of this Act are contained in the following seven paragraphs.

§ 1. The management of the forests is placed in the hands of the higher forest authorities and officers; the supervision of the management is given to the district civil officer.

§ 2. The following are to be looked upon as the items of management:—

a. The laying down of fixed plans of operation for the purpose of ensuring a lasting supply of wood;

b. The appointment of supervision of the yearly felling and cultivation;

c. The fixing proper and regular divisions to be cut yearly, and rendering an account of the proceeds of the same;

d. The assignment of permissible minor forest products, such as seed, foliage, grass, pasturage &c.

The administrators have not the right to determine how the felled wood shall be used or sold to the best advantage, after it is felled the proprietors are at liberty to deal with it as they like.

§ 3. By the laying down of the general plan of operations and the yearly estimate of felling and planting the forest proprietors or their representatives are to be allowed on application a conference with the forest officer in order to state their views and wishes, and every consideration is to be given to their proposals so far as this can be done without prejudice to the forest.

Should the proprietors not be contented with the plan of operations the district officer has to decide for or against it, and in the event of an appeal from his decision the duty devolves upon the Minister of the Interior, whose verdict is final.

§ 4. The proprietors must perform or hire others to perform at their expense the fixed fellings, plantings, and other improvements according to more detailed instructions from the administrators, and should the forest officer find it necessary to send his own workmen to carry out his orders the proprietors are responsible for their wages.

§ 5. The proprietors have further, in proportion to the necessity and according to more detailed instructions from the administrators, to make the necessary arrangements for the protection and preservation of the forests. They have also, if their revenue permit, and if the extent of the forest is proportional to the outlay, to employ an overseer solely for that purpose.

Where the forest is small, and if the circumstances admit of it, the proprietors of two or more forests can employ such an official conjointly. The overseers are under the orders and supervision of the government forest officer, who has to make the necessary provision and regulations for the

protection of the forest, and who although not obliged to has the right of enforcing such regulations himself.

§ 6. The proprietors can keep the accounts but the forest officer is obliged to keep the memoranda of felling, &c., and the register of the workmen's wages.

§ 7. The forest proprietors must pay yearly the sum of one groschen* pro morgen† (1·85 of a penny per acre) forest land to the Government as a contribution to the salary of the administrating forest officer. There are no other payments for the management of the forest required. The transactions entailed in consequence of this law between the different authorities are free of all expense to the proprietors.

The manner in which the above law was to be carried out was determined on the 26th July 1859 by the joint orders of the Minister of the Interior and the Minister of Finance and it may be exemplified by the following data received from the Oberforster Köhler of Nienburg, who has about 5,000 morgens of village forests attached to his revier.

The Oberforster or executive officer in charge of a district, to whom the administration is given after he has inspected the forest accompanied by the representatives of the villagers and explained to them what he intends doing, has to draw up a plan of the cutting and planting in September for the ensuing year.

The plan is then laid before the Forstmeister or inspecting officer in charge of a forest division for revision, and after this has taken place it is handed back again to the Oberforster with any necessary alterations and remarks. After the receipt of the approved plan the Oberforster holds another consultation with the deputation from the villagers.

The Oberforster has to keep a protocol or record of the proceedings at this consultation which, when there are no alterations desired in the plan by the representatives, is drawn up in the manner shown at the end of this paper. The matter is herewith settled and the plan ready to be carried out.

Should, however, the representatives make objections to the plan proposed, such objections are to be noted down in the protocol and sent to the Forstmeister for revisal. Should the Forstmeister think fit, he can talk over the matter with the representatives in the forest itself, and he should have regard to their desires as far as he can do so without damaging the forest.

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* One groschen = 1 · 2 of a penny. One morgen = 0 · 6477 of an acre.

If the Forstmeister permits the alterations, or if they are withdrawn by the representatives, the former has to acquaint the Oberforster of the fact, in order that he can proceed to carry out the plan.

In the event of the Forstmeister being of opinion that the desired alterations deserve no attention, or if the representatives refuse to withdraw them, the Forstmeister must either,

(1.) In the event of the representatives not having requested a conference with the co-operation of the civil sub-district officer, which they are entitled to do, lay the plans for decision before the chief civil officer of the district, or

(2.) Hand them to the sub-district officer, should the representatives have requested such a conference.

In the latter case the sub-district officer conjointly with the Forstmeister, fixes a day on which to settle the matter, notice of which must be given to the representatives. Should the latter fail to put in their appearance, the sub-district officer and the Forstmeister send without delay a joint report of the circumstance to the district officer for his decision in the matter. In the event of the representatives appearing, the plan and proposed alterations are to be discussed, and both the sub-district officer and the Forstmeister should do their utmost to bring about an agreement. If, however, they find this impossible, a record of the proceedings, together with a joint report, is to be sent to the district officer.

The district officer has to communicate his verdict to the representatives through the sub-district officer, and the latter has also to notify it to the Forstmeister.

A further appeal to the Minister of the Interior against the verdict of the district officer, must be sent, together with the grounds for the appeal within 20 days after the receipt of the decision to the Forstmeister for transmission.

After the receipt of the decision of the Minister of the Interior or after the expiration of the term for appeal, the Forstmeister has again, after having made the necessary alterations if any have been determined upon, to send the plan to the Oberforster for execution.

The plan having thus been finally settled (no alterations whatever, can now be made without the sanction of the Forstmeister), is to be at once carried out and a copy of it sent to the representatives.

The Oberforster or one of his försters, if he care to entrust him, must give the overseer or workmen the necessary in-

structions regarding the felling and planting, &c.; he must especially mark out the extent of the felling, check the work done as much as possible, provide for the timely and proper execution of the same, and, if it is desired, assist the representatives to value the wood.

Only good and skilled workmen are to be employed, and the Oberforster has the power, in the event of useless or idle workmen being engaged, to dismiss them and demand that the representatives provide more capable men. If this is not immediately complied with the Oberforster can, without more ado, send qualified men himself to do the work, and the proprietors are responsible for their wages.

The proprietors are bound to comply with the forest regulations; in the event of non-compliance the Forstmeister has the power to threaten with punishment, and when necessary give weight to this threat by inflicting a fine not exceeding 50 thalers (7*l.* 10*s.*).

In the event of a fine being imposed the person is to be warned to pay it to the sub-district officer before a certain date, and that officer is to be informed that it is due.

Should the proprietor believe that he has been unjustly fined he can appeal to the district officer, and from his decision again to the Minister of the Interior.

The Oberforster has no power to impose a fine himself, but must report any case in which he thinks the imposition of one necessary to the Forstmeister.

The proprietors elect the overseers, but the Forstmeister and sub-district officer have to confirm their choice, and they should be careful to see that the following conditions have been paid attention to:—

a. On hiring the overseer a quarterly notice to quit should be reserved;

b. The overseer's wages must be liberal, in order that he may give up his whole time to his duty;

c. He is to receive no minor forest products of any nature whatever in lieu of wages;

d. The overseer must be sworn in.

It is the duty of the Oberforster and his försters to see that the overseers do their duty with zeal and impartiality, and that they report all irregularities, misdemeanors, and infringements of the forest laws either by the proprietors or by others.

The Oberforster has the power to dismiss any overseer.

The proprietors cannot dismiss an overseer without the sanction of the Oberforster. Should differences occur on

this point between the Oberforster and the proprietors, the Forstmeister and sub-district officer have to decide.

With regard to theft on the part of the proprietors, as well as strangers, the Oberforster takes the same course as he would had it occurred in a government forest.

After the operations have been carried out for the year, the Oberforster has to draw up an abstract showing in what manner they have been executed. He has also to keep a memorandum for each village forest under his charge, consisting of three parts :—

1. Account of the felling ;
2. Minor products of the forest ;
3. Cultivation, &c.

All the reports, viz. :—

a. Copy of plan of operations, together with protocol;
b. Abstract as to how the plan has been carried out; and
c. The memorandum of felling, &c.,

are to be laid before the Forstmeister for revision before the month of May of the following year, who returns them to the Oberforster to be placed in his register.

It is undeniable that these forests have already greatly benefited by this law, although it has been such a short time in force, and in spite of the fact that the proprietors, who believed they saw in the law an infringement of their rights, at first put every obstacle they could in the way of the administrators. They soon, however, saw the benefit which they themselves derived from the introduction of a proper and scientific system, and now do all in their power to assist the forest officer, and no longer object to lay out money, which was the great obstacle at first, now that they have convinced themselves that they are the gainers by it.

Surveys, when they are necessary, are done at the cost of the proprietors; should they object, they must appeal to the district officer, whose decision is in this case final.

COPY OF PROCEEDINGS.

(Referred to at page 157.)

FOREST DISTRICT, NIENBURG. FOREST OF NIENBURG.

FOREST OF THE VILLAGE STEIMBEK.

PRESENT:

Representative of the Forest Department.

I, the Oberforster Köhler.

Representatives of the Villagers.

The peasants:

Runge, Haselbrinck, and Vogeler.

Transacted in the "Jug Inn," at Steimbek, the 1st February 1870.

The proposed plan of operations in the forest was read and explained today.

No alterations in the plan were desired by the representatives of the proprietors of the forest.

Read, approved of, and signed.

RUNGE.
HASELBRINCK.
VOGELER.

Witness,
KÖHLER,
Oberforster.

VI.

Extract from a Report on the Natural Oak Forests of Sussex, by T. W. Webber, late of the Forest Department, India.

Natural Oak Forest.—The portions of Hants, Kent, Surrey, and Sussex, known as the "Weald," lying between the chalk hills of the South Downs and the northern chalk formations, was apparently at one time a dense oak forest. The soil, which is a stiff yellow clay, called Weald clay, in places alternating with Hastings sand, stretching from Ashford, in Kent, almost to the New Forest in Hants, seems to be the natural habitat of the English oak, *Quercus Robur var. pedunculata.* Seedling oaks spring up readily, and it seems probable that, if cultivation ceased, forest would gradually take possession of the soil. So rapidly and luxuriantly does the oak grow, that it keeps a firm hold of all banks and hedge-rows where the plough cannot disturb it, and where the farmer is not allowed to cut it, and any waste strips too rough for tillage have only to be enclosed to spring up into oak-wood. The landlord sometimes receives as much annually from the timber cut in the hedge-rows, as he gets from the rent of the land.

Management of Oak-woods.—This is done partly on the coppice principle. The young self-sown plants are permitted to grow as thickly as they will with the copse shoots for ten years. Every ten years the underwood is cut, and "tellers," or young seedling oaks, are left standing at equal distances about 10 feet apart. Where seedlings are not found, copse shoots are chosen, which have grown from small standards, not from old and decayed stools. These are in some places preferred to seedlings, as they grow quicker and are found to reach the age of 90 or 100 years with as sound a butt and as straight a stem as need be desired. There is, however, always a curled and suspicious look about the grain of these trees when cross-cut close to the ground; but this does not extend up the butt. For older growth than 100 years, seedling oaks are preferred. At each decennial copsing, the tellers are looked after, thinned out when required, and gaps filled in from the younger growth. The thinning is gradual, the rule being always to leave the best with a view to the final crop, which is cal-

culated at 40 oaks per acre. The mature age is estimated at 100 years, but this is rather a traditional than an actual estimate, and it is the practice apparently to leave oaks to stand much longer.

Rule for Thinning.—The rule for thinning is to cut those stems which show symptoms of standing still in their growth, and to leave those which are improving. In 50 or 60 years' old wood, the standards are generally found 80 to 100 per acre. In a copse-wood at Heartswood, Sussex, grown from the natural-sprung seedlings, the standards were about 90 per acre. I measured some 4 feet 6 inches in girth, and the smallest measured 2 feet; they contained from 10 to 20 cubic feet. These oaks were straight and well grown, with leafy heads, and covered the ground very evenly. I was informed that this land was a rough meadow, on which hay was made as late as 1810. The only step taken had been to enclose it, when the oaks sprung of themselves, a regular thicket mixed with hazel and a few birch. By careful management it was brought to its present thriving condition.

Method of Cutting "by Groups."—The method of cutting is similar to the German "group culture." The forest, when arrived at maturity, is not quite cleared away; it is rather cut in small patches of 1½ acres to 1 acre each; these patches are cut clean, with a view to an even crop of coppice and seedlings succeeding. The surrounding forest supplies seed and shelter. In no case are single trees selected to be cut in the forest. This would be followed by most disastrous results:—*first*, such a system leads to a fallacious estimate of the crop. The good trees would be sure to disappear, and in time, the owner, imagining he had still so many acres of standing forest, would some day find he had only so many acres of rubbish, while no fresh crop had come in its place, owing to the day-light being excluded, as it soon is, in the gaps, by branches closing in overhead. *Secondly*, old oaks which have long stood together sheltering one another without crushing, are found to be so necessary to one another's existence, that when one is cut, the others assume a stag-headed, scald appearance, and die, or at least cease to thrive. It is necessary, therefore, to take the whole group, or nothing at all, being careful not to expose another neighbouring group to the prevailing wind.

Natural Edges to Groups followed.—And even when the exposed side is not towards the wind, care must be taken to adopt the natural subdivisions of the forest, and cut only up

to a point where the foliage of the trees may happen to feather down to the ground, forming a protection to the outside stems. In no case must the cutting abruptly cease where the stems left are bare and unprotected from the blast, else they will certainly die, or be so checked, that they will cease to improve. Care must also be taken, for the same reason, when cutting the hedge-row oaks, never to cut one of two sister oaks which have long stood together. Either both must be cut, or neither. This system of cutting in groups is very old in Sussex, and has proved itself the most successful one. It seems suitable to natural forest in India, and its maxims are very applicable.

Pruning entirely deprecated.—Here the branches of oak trees are never cut or pruned in any way. It is considered that the damage caused by letting in the air to the heart of the stem is most injurious to the timber. The proprietors have, from long experience, followed the plan of leaving nature alone, and letting trees shed their superfluous branches by the natural way, and certainly the result seems good; for the stems are very clean, exhibit no marks of mutilation, and the timber is sound. This question is distinct from the question of how trees should be trained to grow with one leading shoot and as few side-branches as possible. In Germany the side branches are not allowed to come, the trees being grown purposely crowded together while young. In forests where pruning is approved of, the side branches are cut off; but in Sussex, the side branches are permitted to grow. The branch wood, when the arms of old oaks are large, is useful for knees and curved ribs for ship-building. Therefore, the oaks, especially those in hedge-rows, are allowed to produce spreading heads, and in the coppice woods, more or less of a branching top is approved of. The side branches lower down the stem, as the tree gets older, get shaded by the upper branches and die; they dry up gradually and drop off, the bark closing over the place of insertion on the stem by a slow process, which seems to leave no bad effects behind.

Forest Surveying and Valuation.—The timber standing on estates has to be valued for succession duty, on the succession of every hereditary owner, and a very large staff of surveyors and valuators are constantly employed in this duty. The system adopted is one of "*actual measurement*" of every stem in parks, and "*calculation of average*" in young plantations. The surveyor uses a leather strap, weighted at one end, and marked in quarter girth marks of 4 inches each; with this he proceeds from tree to tree,

throwing his strap round each breast-high, and marking in his book the contents of each from tables, the height being measured with a rod to the first branch, and the arms, if any, computed separately; great care and practice is necessary, and constant testing of the result with trees felled; as a little error makes a vast difference in the contents of trees; averages taken in plantations of unequal growth are often fallacious, except in young plantings; therefore actual measurement is aways preferred.

Copse Woods for Hop-poles.—There is a very large area of pure copse-wood in these counties grown for hop-poles. The principal hop-pole district lies between Godalming and Tenterton, comprising the Surrey Hills, which are almost a continuous forest. Spanish chestnut is principally used, and also ash, larch, oak, and other trees. The chestnuts and oaks are planted at 4 feet apart, and cut down every 10 years. In this system of coppice no high wood or large trees are grown. It is pure copse wood; besides the hop-poles there is a yield as in copse and high wood of smaller stuff, hazels, oak shoots, ash, birch, &c. They are about one inch thick, and split up for hoops for sugar and other barrels. There is a large demand for this hooping, which is exported to the West Indies and other places.

Natural Beech Forests of Buckinghamshire.—In Buckinghamshire, on the chalk hills the oak is not the natural timber, but the beech takes its place and springs just as freely, and without artificial means, as the oak does in the stiff clay. The system is one of selection. The rule is to cut the *best trees*, but there is a regular rotation. The mature age of the beech is considered to be 30 to 50 years only; the timber is used for chair-making. There is a great manufacture, by hand principally, of kitchen and barrack chairs; the chair-makers have great skill in this work, and can do it at so low a cost that they almost monopolise a very large trade, and export chairs to all parts of the world. The beech woods of Buckinghamshire are considerable, and supply this manufacture at a fair profit.

VII.

Suggestions concerning the Professional Studies of Forest Officers on Furlough in Europe.

Object and limits of these remarks.

The object of the following remarks is to offer suggestions for the consideration of Indian forest officers on leave in Europe, who may desire to make themselves acquainted with the management of public and private woodlands in this country and on the continent. In February 1867 I prepared a memorandum with the same object in view, and that paper is referred to in some of the preceding Reports. In drawing up the present remarks, which are now intended to replace the original memorandum, I have been guided by the experience gained by forest officers who have, in accordance with the arrangements made in 1866 and 1867, endeavoured to complete their professional studies during their furlough in Europe.

The present remarks will, with few exceptions, be limited to those forest districts with which I am personally acquainted, and I desire to state at the outset that I am not at present in a position to exhaust the subject, for of continental countries I have sufficient personal acquaintance with forest management in France and Germany only, and in a few districts of Italy and Austria; I must therefore leave it to others to indicate those points to which forest officers should devote special attention who may desire to go further. The organisation of the Forest Department in Russia, the system of timber transport in Sweden and Norway, the great differences which existed formerly, and which partly still exist, in the forest legislation of the different cantons of Switzerland, and the effect which this state of things has had upon the condition, not of the woodlands only, but also of the fields and pastures in the different valleys of the Swiss Alps, the gradual denudation of many districts of Spain, the influence of this denudation in diminishing the fertility and the wealth of the country, and the attempts which have been made to counteract these effects, all these will form instructive subjects for the study of such forest officers as may have an opportunity of visiting those countries and learning their language. In Turkey, too, the attempts made some time ago, under the guidance of a number of able French forest officers, to establish a regular forest administration, may be found suggestive in many respects to Indian foresters. Nor is the field of useful studies for Indian forest officers confined

to Europe, or to those countries where the management of natural woodlands and plantations is an old established and recognised profession. The gigantic lumber trade of Canada, the extraction of resin in Florida and Carolina, the effects which forest clearings on the largest scale have had in several of the United States,* all this would afford a vast amount of instructive information to those who are entrusted with the working and the preservation of our forest resources in India. The study of the conditions under which the Wellingtonia of California, and the Eucalyptus of Tasmania, attain dimensions far exceeding anything known in the most luxuriant of our Indian forests would be a task, which an Indian forester, who has the needful knowledge of climate and the growth of trees might undertake with great advantage. Arboriculture in Japan also, will, I feel convinced, eventually prove a source to us of much practically useful information.

Existing arrangements, how utilized.

The present arrangements, which facilitate the professional studies in Europe of forest officers on leave, were made in 1866. *Capt. Seaton*, the present Conservator of Forests in Burma, and *Capt. W. Stenhouse*, at present officiating in Oudh, were the first to avail themselves of them. With great perseverance and industry these officers went through a regular course of studies in the mixed beech and oak forests of Villers Cotterets in France, at Nancy, and in the spruce and silver fir forests of the Western Vosges near Remiremont. They derived great benefit from what they learnt, and their example has been followed by a number of forest officers from different provinces of India. Some of these have, I believe, profited much, and the reports which precede these remarks afford ample proof of the great importance of such studies, when undertaken in the right spirit, and in a proper methodical manner. Others may have returned to India dissatisfied with the result of their professional studies at home; if so, the reason probably was that they went to work in a *dilettanti* sort of fashion, and that instead of going through the labour of mastering the details of forestry, they imagined that their experience in India entitled them at once to come to conclusions of a general and sweeping nature after a hurried journey through the country. On this account I am anxious at the outset to state my opinion in unmistakeable terms that those only should avail themselves of the facilities now offered for their professional studies, who are able and willing to devote sufficient time to them.

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* G. P. Marsh. Man and Nature. London, 1864, pp. 51, 300.

Studies on the continent demand some knowledge of the language.

I will now briefly indicate those points to which the attention of an Indian forest officer on furlough should be specially directed. The first point to be decided seems to be, whether he should attempt a course of studies on the continent, or whether he had better confine his attention to what may be learnt in this country. Some knowledge of either French or German is an indispensable condition of successful studies on the continent, and familiarity with the language will enable him to get through the work in much less time, and in a more satisfactory manner. Should any one desire to study on the continent without a sufficient previous knowledge of the language, then my advice would be, in the first instance, to settle down at a quiet place to learn the language; and after having made some progress, to seek the acquaintance of any forest officers who may reside in the vicinity, so as to become acquainted with the technical terms and expressions used in the profession. For the purpose of learning the language there are numerous places to choose from; should any one desire a hint in this respect, I may state that in France, Nancy for the north, or Aix en Provence for the south, would probably be found to answer; and that in Germany, Hanover, Gottingen, Eisenach, Bumberg, and Stuttgart may be named, but that there are many other places equally suitable.

Professional studies in Great Britain.

To those who have time to study both in this country and on the continent, my advice is, first to go abroad, and then to take up forestry in England and Scotland. This I am inclined to think will be found a good arrangement. As, however, in most cases circumstances may not permit a course of studies abroad, I will, in the first instance, endeavour briefly to indicate the subjects to which attention should be directed in this country. In the reports which precede these remarks the Crown forests and some of the largest and most instructive private wooded estates are mentioned, but there are many others besides, and forest officers on furlough will find ample opportunities in most counties to acquire an abundance of useful information regarding arboriculture. A general book on forestry is the well known work *The Forester, by James Brown, 4th edition,* 1871. *John Grigor's Arboriculture* will also be found useful. Instructive papers on special subjects will be found in the *Transactions of the Highland and Agricultural Society of Scotland,* and of the *Scottish Arboricultural Society.* The *Gardeners' Chronicle and Agricultural Gazette* also has occasional articles on the subject of forestry. But the best school is constant personal intercourse in their forests and woodlands with the forest officers of the Crown forests and

with experienced wood managers and foresters on private estates.

I will commence by a few remarks on coppice woods, the management of which is more simple than that of high timber forests. I would draw special attention to the laying down and treatment of Osier beds, which may be seen in great perfection along the Thames and elsewhere. Such coppice of willows, which is cut over annually or every second or third year, yields a high rent on good soil, the material being used by the basket maker and cooper. In India we have nothing exactly like it at present, but I am inclined to think that similar short rotation coppice woods of willows or other fast growing trees might be made to yield a good return. Oak coppice for bark, the stripping and drying of bark for tanning, mixed coppice of hazel, lime, and other trees, coppice with standards of oak may be studied in most counties, and it is not necessary to mention particular localities. The main points to which attention should be directed are, the length of rotation, which will be found to vary within wide limits, according to climate, soil, kinds of trees and the requirements of the market, the quantity and value per acre of the crop at the fall, the intermediate thinnings, the number of standards, if any, per acre, and their share in increasing the value of the crop. In some places the yield of the coppice is considerably increased by planting larch and other coniferous trees with it. The coppice woods without standards for the growth of hop poles in Surrey, Sussex, and particularly in Kent, merit special and careful study. In 1866 I had the privilege of visiting the woods of Sir Edward C. Dering, of Surrenden, near Ashford, and I must say, I have seen nothing anywhere in Europe to be compared to them. The ground is carefully trenched; ash and Spanish chestnut are planted close together, often mixed with larch, and the results, both as regards rapidity of growth, length of poles, and the money returns realised, are very remarkable. It is instructive to compare these carefully tended and highly productive woods with the old natural coppice, which often yields a very small return. Sir Edward has been good enough to state that any of the forest officers from India who may wish to inspect his plantations are at liberty to do so, if furnished with the needful introductions from the India Office. Coppice woods.

Oak and mixed coppice with a large number of oak standards is a form of forest not uncommon in the south of England, similar in many respects to the "Taillis sous futaie," generally found on private estates in the north and centre of France. The coppice keeps the ground under cover, draws up the younger standards, and yields an additional Coppice with standards.

return. The part which is here performed by the coppice will remind Indian foresters of the beneficial effects of Bamboo underwood under Teak, or of Tamarisk wood under the Babul and Euphrates Poplar in Sindh. In one of the preceding reports a sketch of the self-sown Oak woods of Sussex is given. The timber is here the main crop, but it is raised with the aid of the underwood.

Timber forests with natural reproduction.

Considerable extents of natural high forest, mainly maintained by self-sown seedlings, are to be found in various parts of the country. The natural forests of Scotch fir in the Highlands have been described by Captain Walker, and the beech of Buckinghamshire is mentioned in Mr. Webber's report. The management of these beech woods is exceedingly interesting; they are uniformly dense woods, the trees not full grown; where I have seen them they appeared to be between 60 and 80 years old, but sufficiently mature to shed seed. There is a sprinkling of ash, whose light green foliage overtops the more yellowish green heads of the beeches. The cuttings, which go through the forest in a regular rotation, merely consist in thinning out a small proportion of the larger trees. Small blanks are thus formed, which are filled up readily by self-sown seedlings. The system is exceedingly conservative, the soil improving steadily by the mass of vegetable mould formed by the decaying beech leaves, and it is probable that if there were a sufficient demand for this description of wood, some of these forests might be made to yield a larger annual crop than they are said to yield at present. Excellent Scotch fir woods of considerable extent, originally planted, but now maintained mainly by natural reproduction, may be seen in Windsor Forest, near Swinley and Sandhurst, and generally it may be said that the maintenance of timber forest by self-sown seedlings of oak, birch, beech, Scotch fir, and even of larch and spruce, is understood and utilised in many places, so that there is no lack of opportunities in acquiring useful information on this branch of forestry, which is particularly important for Indian foresters.

Plantations.

Plantations, however, are, *par excellence*, the strong point of arboriculture in Great Britain. As far as my experience goes, there is no country in Europe where plantations on a large scale are made at a less cost per acre (considering the rate of labour) or with more uniform success. The continuously moist climate, without any long-continued droughts is a great help in this respect, but the skill of nurserymen and foresters is, I believe, the principal element of success. In order to understand the selection and treatment of seeds and the management of nurseries, it will be well to spend some time at the great nursery of the Lawson Seed Company,

near Edinburgh, or any other large forest nursery. Plantations are often made by contract, and I have seen extensive and very successful plantations in the North which had been raised in that manner; a study of the conditions usual in such contracts will be found instructive. For the planting of oak with the aid of nurses of coniferous trees, no better school could be recommended than Windsor Park, the New Forest, and Dean Forest. The procedure in each of these has its peculiar points, which must be studied on the spot. For larch and Scotch fir plantations, Strathspey, the estates of the Duke of Athol and the Earl of Mansfield, in Perthshire,* are particularly instructive, but forest officers should not confine their studies to these localities. Indian foresters will naturally desire to inform themselves regarding the cost of plantations, as compared with the value of the thinnings and the final crop per acre, and on many estates these figures are readily available, but it may not be out of place to guard against publishing such information, or inserting it in an official report without due authority from the proprietor or his agent.

Their management.

The formation and management of plantations comprises a wide range of subjects; it will be sufficient to mention a few to which attention should specially be directed The different descriptions of fences can be studied better in this country than I believe anywhere else. The great mass of the public forests in India will probably remain unfenced, just as with few exceptions, the large public and most of the private forests in France and Germany are not surrounded with fences, but in certain special cases fencing will be found indispensable in India.

The comparative merits of pit planting and notch planting, L and T slit under different circumstances, the use of the spade or hand iron † in different soils and with different kinds of trees; these are matters the study of which will be of direct practical use in India. Early and oft repeated thinnings are to a certain extent a peculiar feature of Scotch and English forestry, and much may be learnt in this respect by Indian foresters. I am well aware that under the powerful light and sun of Indian latitudes (10°—34°) forests and plantations require to be kept more close and compact, and the ground more completely covered than is desirable in lat. 55°, but then there is hardly any operation of forestry, which can with advantage be mechanically copied in another

* It may be useful here to state that in Scotland the best seasons for studying planting work are, in Perthshire, early spring, from February to April; and in Strathspey, April to July.

† A remarkable kind of spade, with a triangular blade which ends in a narrow prong 16 in. long, is used in the New Forest for planting hardwood and coniferous trees.

country, or even in another county. The object of studies like those here recommended is not to acquire empirical knowledge of planting and thinning as done in Perthshire or Gloucestershire, but to understand the principles which guide foresters in the successful management of their plantations.

Working of the forest and forest rights.

Much may be learnt in the matter of timber sales and working of forests. Notices and conditions of sales should be studied and information collected regarding the prices realised in different localities and under different circumstances. The valuation of standing timber for sale and for other purposes will afford much instruction. The construction and use of portable saw mills and of water power saw mills of simple construction can nowhere be studied more advantageously than in Strathspey and elsewhere in Scotland.

Regarding the important subject of forest rights it will suffice to refer to *Capt. Walker's* account of the history of the New Forest and Dean Forest, and to add that those who may desire to study the legal bearings of this subject, should consult a small book by Wingrove Cooke, "*The Acts for facilitating the Inclosure of Commons, with a Treatise on the Law of Rights of Commons. London*, 1864." An old work by John Manwood, "*A Treatise of the Laws of the Forest. London*, 1665," contains much information concerning the history of forest rights. The *Register of the Decisions of the Commissioners for the Settlement of Claims upon and over the New Forest, appointed in* 1854, has also been printed under the authority of the Treasury in a small octavo volume, which gives a detailed account of every forest right allowed in that forest.

Most branches of the subject may be studied in this country.

The preceding remarks will show that there is hardly any branch of forestry which cannot to a certain extent be studied in this country. There is, however, this difference that in France or Germany the public, that is, the state or communal forests, and those large private forest properties which are managed on the same principles, are much more extensive, and form large compact masses, which are managed by great and well organised departments, the officers of which have all received a special professional education, practically and theoretically. The great branches of forest business, the settlement of forest rights, the protection of the forests, their working and regeneration by natural or artificial means, and their improvement and extension, all this has during a long series of years gradually come to be arranged in a methodical and systematic manner in the public forests. Complete financial results of their management are periodically made public, and are constantly

discussed and criticised by professional foresters. Thus it is easier to acquire correct general notions and principles by studying the management of the large continental forests, and on this account I have recommended to those who can afford it to commence by going abroad, because their studies abroad will enable them to utilise their time better, when completing their studies in this country.

Introduction of exotic forest trees.

There are numerous other subjects connected with forestry to which forest officers on furlough in this country may with great advantage direct their attention Foremost stands the introduction of exotic trees. In this respect Great Britain has always taken the lead. Indian foresters will naturally in the first instance, direct their attention to the cultivation of the Deodar and other Himalayan conifers. In that respect the experience gained in Windsor Park, at Dropmore, Ealing Park, and Kew, is exceedingly instructive, but the growth of the Deodar may be studied in almost any park in England and the south of Scotland. The practical lesson which Indian foresters will probably draw from the study of this subject will most likely be, that such trees as the cedar of Lebanon, the Deodar, the Douglas pine, succeed wonderfully well as ornamental trees in this climate, but that their value as forest trees for the production of timber in this country is doubtful. Studies of this kind will serve to make them cautious in acting upon the numerous well meant suggestions which are offered on all sides for the introduction of foreign trees into India, and for the cultivation of Indian trees beyond the range of their natural distribution. On the other hand the larch itself is a striking example of the successful introduction of an exotic forest tree. Indigenous in the clear and dry atmosphere of the Alpine regions of Central Europe, and nowhere cultivated on a large scale in this country before the commencement of the present century, it is now so completely naturalised in Scotland, that it is second in importance only to the Scotch fir among coniferous forest trees. And yet, though in several places the larch propagates itself readily by self-sown seedlings, it does not, save under very favourable circumstances, remain sound and healthy until it attains to mature age. In India foremost among introduced forest trees stand the Eucalyptus and Acacias from Australia, some species of which have changed the aspect of certain parts of the Nilgherris, and there seems every prospect of Cinchona coppice woods becoming a most important description of Forest on the higher mountains of India.

The durability of different descriptions of timber under different circumstances is another subject, regarding which useful information may be collected in this country, in so

far as it will suggest simple methods of ascertaining the relative durability of different kinds in India. We are in darkness regarding the comparative durability of most of our Indian timbers, mainly because it appears a formidable undertaking to watch them sufficiently long. But there is no doubt in England regarding the comparative durability of split and sawn oak, larch, or Scotch fir as posts, palings, or pitprops; it is generally fairly well known how long a wood of a certain kind and age will last under certain circumstances, and yet most of this information has been acquired and confirmed merely by putting together the ordinary every day experience on this subject.

Navy dockyards.

The storing and seasoning of timber, its conversion at sawpits and sawmills, the different descriptions of scantling used for shipbuilding, may be studied at the navy dockyards with the requisite permission of the Lords of the Admiralty. Chatham and Pembroke are, I understand, the most instructive navy dockyards in this respect. The impregnation of railway sleepers and other timbers with creosote and other antiseptic substances, the manufacture of charcoal, and the comparative value of woods as fuel are likewise subjects which merit the attention of forest officers on furlough.

Surveying. Natural sciences.

Those who may desire to learn surveying and land measuring, or any branch of the natural sciences during their furlough at home will find no difficulty in making the needful arrangements for that purpose, and I need say nothing more about it. It may, however, be well to mention one public institution which should be visited and utilised by all. I mean the Gardens and the Museum of Economic Botany at Kew. These institutions have no equal anywhere as regards completeness and good management, and their importance to Indian forest officers cannot be overrated. Dr. Hooker, the director of these institutions, has authorised me to state that he will be glad to see and to assist with his advice any forest officers who may desire to study botany or other branches of natural history during their furlough at home.

Studies in France.

The general course of studies to be followed in France by Indian forest officers on leave is sketched out in the following regulations which were drawn up by me in 1866, in consultation with a number of French forest officers, and were sanctioned in January 1867 by the then Director-general of Forests:—

Règlement concernant les études des agents forestiers Anglais de l'Inde, en congé durant leur séjour en France.

Art. 1er. Les agents forestiers anglais, auxquels le Ministre de Sa Majesté Britannique de l'Inde permettra de compléter leur éducation forestière en France, seront accrédités auprès de Mr le Directeur Général

des Forêts. Ils se présenteront à la Direction générale des Forêts à Paris et seront munis d'une lettre d'introduction qui fera connaître la durée probable de leur séjour en France. Selon la saison et la durée de leur séjour en France, les localités différentes pourront leur être assignées pour y étudier le régime forestier français.

Art. 2. Le but principal de leur mission sera d'étudier la théorie générale de l'Economie forestière et de suivre l'application de cette théorie dans les forêts françaises. Mais comme les dates d'arrivée et de départ des agents forestiers de l'Inde, en congé, seront variables, il n'est pas possible de les astreindre, pour l'emploi de leur temps, à une règle uniforme et qui soit applicable à tous.

Art. 3. En principe, il convient que les agents en mission consacrent la plus grande partie de leur temps à étudier la pratique du service forestier, et ne viennent à l'ecole, pour y suivre les cours les plus importants, qu'après s'être bien familiarisés avec la technologie forestière et avoir acquis, sur le terrain des forêts une connaissance suffisante des principales opérations forestières et des travaux d'amélioration de toute sorte qui s'y exécutent.

Art. 4. Dans ce but, ces agents seront envoyés successivement dans des résidences forestières offrant des différences bien marquées sous le rapport du climate, du terrain et des essences forestières qui y sont cultivées; soit, par exemple, à Villers-Cotterêts, pour y étudier les futaies mélangées de hêtre et de chêne; dans les Vosges, pour les sapinières.

Art. 5. Pendant le temps (un mois au moins) qu'ils auront à passer dans chacune de ces résidences, l'emploi de leur temps sera réglé de la manière suivante.

Dans chaque localité, ils feront une étude spéciale et complete d'une série ou de deux séries de futaie, qui leur seront désignées par l'agent chargé de les diriger. A cet effet, ils prendront une copie du plan et feront un extrait du procès-verbal d'aménagement de la série à étudier. Puis avec ces documents, ils visiteront et décriront chaque parcelle et ils se rendront un compte exact de toutes les opérations effectuées conformément aux prescriptions du procès-verbal d'aménagement. Ils apprécieront le mérite de ces opérations et ils rédigeront un mémoire, en anglais, dans lequel ils consigneront les principales données du procés-verbal d'aménagement et le résultat de leurs propres observations.

Ils feront un travail analogue sur l'aménagement d'une série de taillis sous futaie.

Chaque fois qu'ils en auront l'occasion, ils accompagneront les agents forestiers dans leurs opérations de martelage, d'estimation et de récolement; ils visiteront les exploitations et, spécialement, les coupes d'éclaircie et de nettoiement; ils feront une étude particulière de tous les travaux d'amélioration à exécuter dans les forêts, tels que semis, plantations, préparation du terrain, création et entretien de pépinières, &ª.

Enfin, si la chose est possible, ils assisteront à des ventes de bois sur pied et de produits façonnés, et, à ce propos, ils étudieront les dispositions principales du cahier des charges générales et du cahier des clauses spéciales relatives aux exploitations et à la vente des coupes.

Art. 6. Les agents anglais tiendront un livre journal dans lequel ils feront connaître l'emploi de leur temps et où ils consigneront les observations de toute sorte qu'ils auront recueillies, sur les différentes parties du service forestier, dans les localités qu'ils auront visitées.

Les agents forestiers français leur délivreront un certificat constatant la part qu'ils auront prise aux travaux qui leur seront prescrits.

Art. 7. Avant de quitter la France, ils se présenteront à la Direction générale des Forêts à Paris, où les certificats qui leur auront été délivrés seront contresignés par M. le Directeur général des Forêts.

Art. 8. Il est recommandé aux agents anglais de se procurer les livres ci-après désignés et de les étudier pendant leur séjour en France :

1°. Cours élémentaire de culture des bois, par M.M. Lorentz et Parade;
2°. Cours d'aménagement des forêts, par M. Nanquette;
3°. Cours d'exploitation, débit et estimation des bois, par M. Nanquette;
4°. Flore forestière, par M. Mathieu;
5°. Manuel du garde forestier, par M. Bouquet de la Grye;
6°. Les codes de la législation forestière, par M. Jacquot.

Haguenau, le 6 Janvier 1867,
D. BRANDIS.

Approuvé :
Le Directeur général des Forêts,
J. LAYDEKER.

Concerning the books on forestry recommended in the last paragraph, I desire to state that M. Bagneris, one of the Professors at the Nancy Forest School, has just published an excellent small handbook, entitled *Manuel de Sylviculture*, which may be substituted for the books mentioned under 1° and 5°. This manual is principally intended for the use of subordinate forest officers, and I understand that the French forest administration has purchased a large number of copies for distribution. It will be found to contain nearly all that is wanted to guide Indian forest officers in studying in France this particular branch of the subject. By way of a general introduction I would recommend the perusal of an essay written by Mr. Sykes Gamble on the State Forest schools of France. (*Transactions of the Highland and Agricultural Society of Scotland*, 1872.) And in order to acquire some familiarity with the current literature of forestry, I would recommend to take in for one year the Monthly French Forest Magazine ("*Revue des Eaux et Forêts*"). With it is distributed to subscribers the *Annuaire*, containing the forest statistics for the year, the classified list of all forest divisions and districts, and a complete list of all public forest officers. A small popular work by Clavé (*Études sur l'economie Forestière*, Paris, 1862), will also be found useful by way of introduction. With the assistance of these publications any one familiar with the language will soon make himself at home in the terminology of the profession, and in those general notions which it is well to possess before entering upon a regular intercourse on professional matters with French forest officers. I would not recommend any one to commence his regular studies in France, or to present his official letters of introduction, unless he be sufficiently acquainted with the language.

Natural reproduction the rule.

Forestry in France has certain marked peculiarities and strong points which it may be well briefly here to indicate. *Natural reproduction* is relied upon to a much greater ex-

tent than is the case either in this country or in north and middle Germany; and upon the whole it must be said that the young and middle aged forests which have grown up under the systematic management of the last 60 or 80 years are in a very satisfactory state. I am not now speaking of coppice woods and coppice under standards where natural regeneration is easy, and follows as a matter of course, but of the high timber forests, both of coniferous and leaf-bearing trees. The moist, and upon the whole mild, climate of most parts of the country is a great help in this respect, but much is due to care and good management.

Great variety of forest trees.

Another point is, that the woodlands of France are composed of a much greater variety of trees than those of England or Germany. The different kinds of oak are the most important forest trees in France, and as the requirements of the two principal species of oak are similar in many respects to those of the teak tree, the treatment of the oak forests in France deserves careful study. I would draw special attention to the pure oak forests (of *Quercus pedunculata*) on the deep alluvial soil along the Loire, Adour, and other rivers of western France, and the mixed oak (chiefly *Quercus sessiliflora*), beech, and hornbeam forests which are found in most parts of central France. A small pamphlet by Bagneris and Broillard (*Etude sur la production du Chêne*, Paris, 1870) will be useful as a guide. The pruning of the oak standards with coppice underneath is done with great skill and on a large scale in many private woods of central France, and Indian foresters will do well to make themselves acquainted with the experience of those who are in favour of extensive pruning, and the views of those foresters who desire to restrict it to the removal of dead branches and of side shoots of stems suddenly placed free. Oak coppice for the yield of bark of the two species mentioned, and of *Quercus Tauzin* in the West, of *Quercus Ilex* and of *Quercus pubescens*, (the southern variety of *Quercus sessiliflora*), in the south of France, as well as the small scrub coppice of *Quercus coccifera*, the kermes oak, are all worth studying. I strongly recommend the management of coppice for bark under different circumstances, not in France only, to the careful study of Indian forest officers, for there seems little doubt that the best mode of treating *Cinchona* plantations will eventually be as coppice woods. The cork oak forests of the *Provence* will afford another subject full of instructive information, and I desire to draw special attention to numerous well managed private estates between Hyeres and Draguignan, in the granite hills of the Maures, where the cork oak is grown mixed with *Pinus halepensis* and *P. Pinaster* (*maritima*). The attempts made to protect these forests against the fires of the hot and dry

summer months will be found to suggest similar measures for some of the Indian forests.* Of coniferous trees I will name the silver fir of the Vosges and of some parts of the Pyrenees, particularly in the *Département de l'Aude*, South of Carcassone, the larch forests of the Alpine districts, the forests of *Pinus Pinaster* (*maritima*), of southern and western France, and those of *Pinus Laricio* in Corsica. The arborescent vegetation of that island presents a marked succession of forest zones, according to elevation, instructive in many respects to the Indian forester. Above the vast extents of *Mäki* (thick and dense brushwoods of *Phillyrea*, *Pistacia*, and other evergreen shrubs) which occupy the hilly land along the coast, are found, principally in sheltered and moist valleys, high timber forests of *Pinus Pinaster* and *Quercus Ilex*, and vast orchards of the sweet chestnut (*Castanea vesca*). At a somewhat higher elevation commences the region of the Corsican pine, forming extensive forests, pure below, and mixed near its upper limit with the beech and silver fir, which form the last and highest belt of arborescent vegetation in the mountains of Corsica. *Mathieu's French Forest Flora* will be found an excellent guide to those who desire to become familiar with the trees and shrubs of the different parts of France, and as an additional help I will mention *Le Maout et Decaisne Flore des Jardins et des Champs*, Paris, 1855. Two of the coniferous trees are important on account of the resin which they yield. The extraction of resin should be studied either in the *Pinus Laricio* forests of Corsica, or in those of *Pinus Pinaster* in the *Départements des Landes* and *de la Gironde*.

Planting of the Dunes.

Though in France the regeneration of existing forests is as a rule effected by self-sown seedlings or coppice shoots, natural reproduction is aided whenever necessary by planting and sowing, and plantations on a most extensive scale have been made and are in course of progress in order to clothe shifting sands or barren hills with forest. I do not know of any more instructive case of planting on a large scale than the forests of *Pinus Pinaster*, which now cover, with few breaks, the Dunes, on the coast of the Atlantic, between Bayonne and the mouth of the Gironde, a length of nearly 150, and a breadth of from two to six miles. The destructive progress of the shifting white sands of these Dunes inland is well known; fields, villages, and churches were covered by them, and all attempts to fix and to clothe them permanently with vegetation remained fruitless until 1787, when Brémontier, an engineer, succeeded in devising

* An excellent book to be consulted on the Forests of the *Provence* is, Charles de Ribbé, *La Provence au point de vue des Bois, des Torrents et des Inondations.*

means to protect the sowings against the drifting sand. The method must be studied on the spot, and no forester from India who has the privilege of completing his professional studies in France should neglect the opportunity of seeing this splendid work of arboriculture. Apart from the Dunes, a visit to the country about Dax and Mont-de-Marsan will prove instructive in many respects. The vast communal lands of the *Département des Landes*, formerly nothing but poor grazing grounds, swampy and uninhabitable during great part of the year, and to a great extent impassable, except on stilts, have now been made productive by draining and extensive sowings of the *Pinus Pinaster*. Then there is the collection of resin, the manufacture from it of oil of turpentine and other products, and near Dax, the well-stocked forests of *Quercus pedunculata* on the rich alluvial soil along the Adour river.

Replanting of barren hill sides.

Much has of late years been done for the planting of barren mountain sides in the Alps, the Pyrenees, the Cevennes, the Auvergne, and other mountains of Central France. The object of these plantations has been twofold; one was to improve the productiveness of these mountain lands, the other object was to prevent the formation of torrents and ravines, to fix the loose soil on steep slopes, and thus gradually to diminish the mass of sand and stones which otherwise is carried down annually into the valleys, causing the wholesale destruction of fields and pastures. By clothing barren hill-sides with wood, both the superficial drainage of the country, and the infiltration and underground drainage are better regulated, and hopes, which seem well grounded, are entertained that these plantations will not only prevent the further deterioration of pastures and other lands on the slopes and in the valleys, but will eventually, to a certain extent, diminish the damage done by inundations, which have always been exceedingly destructive in the basins of the Loire and Rhone. These objects could not have been attained had the forest administration limited its operations to lands at the disposal of the State; legislation therefore became necessary, to enable them to operate where needful, in the same manner on communal and private lands. This led to the passing of two important enactments, the *Loi sur le reboisement des montagnes*, of July 1860, and the *Loi sur le gazonnement des montagnes*, of June 1864.* The provisions of these laws, the experience gained in carrying them into effect, the attempts which have since been made to modify them in a retrograde manner, and the discussions regarding the practical advantage of these

* The legislation on this subject should also be consulted. (Code des Dunes, 1801, 1810, 1817, 1862.)

measures, which are far from being closed, all this will be found highly instructive. Official reports concerning the progress of these operations have been published from time to time. With the guidance of these reports and of the advice of the Director and Professors of the Forest school at Nancy, it will not be difficult to frame a plan to visit some of the most instructive of these fields of operations. The system of barriers or embankments (barrages) across the ramifications of mountain torrents, which has been adopted with great success in the Alpine regions of France (*Département des Hautes-Alpes et des Basses-Alpes*) in connexion with planting and sowing, deserves special attention. Embrun, Gap, and Digne, are perhaps the best starting points for excursions to see what has been done in this respect. An excellent work on the formation and prevention of mountain torrents is *A. Surell, Étude sur les Torrents des Hautes Alpes*, 1844.

Timber sales.

In the State forests, and as a rule also in the communal, and even in many private forests in France, the timber is sold standing, the trees to be felled or to be reserved being marked by the forest officer or the agent of the proprietor, and the purchaser, upon whom the entire working devolves, is bound by stringent conditions of sale and under severe penalties to fell nothing but what has been sold to him, and to protect the reserved trees and the young growth from injury. Large periodical auction sales are held at the chief towns, when the standing produce of the next year's cuttings in the State and Communal forests of the district is sold to the highest approved bidder. These sales are generally held in autumn, and I would advise all forest officers who may be studying in France to make a point of being present at one of these sales. The conditions of sale (*Cahier des charges* and *clauses spéciales*) should be studied, as well as the detailed list of lots to be sold, which states the number and description of trees, the area of the coppice, the limits of the cutting, the lines of export, and the outlay for the repair of roads, planting, pruning, and other improvements that will have to be borne by the purchaser. This system of selling the produce of entire cuttings standing, I am inclined to consider as one of the most remarkable features of forest management in France. A large class of timber merchants, who understand their business, and are generally men of substance, is the result of this system, which is in accordance with old custom, but has been steadily improved and developed. As far as my experience goes, the conditions of sale are strictly enforced, and the regeneration of the forests is not materially impaired by this mode of working them. Those who have served in the Forest Department of Burma will at once see the analogy which exists

between the permit system under which a portion of the Government forests in that province have for some time past been worked, and the system of timber sales in France, and to them it will be instructive to learn that it is possible so to frame the conditions of sale as to secure the conservancy and improvement of the forests, though the working may be in the hands of the purchaser.

The French forest law.

The *Code Forestier* of May 1827, the history of the forest legislation which preceded it, and the additions subsequently made, deserve careful study. Forest officers studying in France will do well to make themselves acquainted with the practical working of the French forest laws, which I have no hesitation in saying are logical, efficient, and at the same time in a high degree considerate. I desire to draw special attention to the provisions of sections 3–6, which relate to the sales of forest produce, and without which it would not be possible to frame and enforce the conditions of sale as they are; also to section 8, on forest rights, under the operation of which the rights of wood and pasture, which formerly burdened the public forests, and greatly interfered with their economical management, are gradually being extinguished, being compensated by the grant of land or by money payments. Indian foresters will do well to make themselves familiar with the provisions of this section and with their practical application. Punishments of offences against the forest laws have, I understand, become comparatively rare in most parts of the country since the system of extrajudicial settlement of penalties and damages between forest officers and offenders has become generally authorised. These "*transactions avant jugement*" are now resorted to whenever possible, in order to prevent the case going into court. The offender is generally found ready to pay the amount fixed by the forest officer under the rules and regulations laid down for his guidance, in order to avoid appearance in court and the risk of heavier punishment. On the other hand the forest officer's time is saved, and what is worth more than all the rest, no ill feeling is roused by dealing with forest offences in this quiet business-like way. A better understanding is maintained between the population in the vicinity of the forests and the forest officers, while at the same time the prevention of offences is said to be as efficient as if every case were brought into court. The rules under which such "*transactions*" are authorised were issued in December 1859, and their working will be found instructive and suggestive in many respects.

Work of a district forest officer in France.

Indian forest officers will be glad to make themselves acquainted with the exact nature of the regular work per-

formed by district forest officers in France. A small hand-book by *Puton*, one of the professors at Nancy, "*Service administratif des Chefs de Cantonnement, Nancy*, 1870," will be found useful in this respect. Everything is arranged in a methodical and systematic manner down to the form of the note books (*calepins*) used in the operations of marking trees to be felled or reserved in a cutting, and revising the cuttings after the purchaser has completed his work.

The French Society of Foresters (*Société Forestière de France*) is an excellent private institution representing the special interests of forest property and encouraging the progress of sylviculture in all its branches. Among its members will be found some of the largest forest proprietors, as well as some of the leading public forest officers. The meetings of this society are held at Paris from January to April. Foresters from abroad are admitted as visitors if introduced by members.

As regards the time of the year most suitable for studying forestry in France, I would suggest to commence early in spring, and to devote March to July to a number of forest districts in the manner indicated in the Règlement. The latter part of summer and autumn would then remain for the study of those special matters which have been mentioned in the present remarks. A residence at Nancy (but not during vacation time) should, under all circumstances, be included in the programme.

Studies in Germany.

Those who desire to go through a course of professional studies in Germany should bear in mind that the administration of the public forests is different in the different States which compose the German Empire. Each country and province has its peculiarities, its strong and its weak points. A comparative study of forest legislation and forest management in the different German States would be highly instructive and suggestive for Indian forest officers, but this is a task which would demand perfect familiarity with the language and with the profession of forestry, and I would not recommend Indian foresters to undertake it. Here, as in France, it will be preferable to confine ourselves to the study in detail of a few forest districts, or rather portions of districts. The best guide in every instance will be found to be the working plan (Wirthschafts plan). With its aid and the assistance of the district forest officer, it will not be found a difficult task to acquire a good knowledge of the present state of the forest, of its history, and of the projects and intentions regarding its future. A tracing of the working map (Bestandeskarte, Wirthschaftskarte) should be made, and with this and the needful extracts of the working plan in hand, one compartment after the other of the district

should be visited and examined. In the first instance I would advise to seek those compartments which contain forest of mature age growing under different circumstances of soil, elevation, and exposure, and to endeavour to form an idea of the number of stems per acre, their aggregate sectional area, the height of the forest, and the quantity of timber standing on an acre (or hectare). The mode of ascertaining the quantity of standing timber on a given area (Massenaufnahmen) and its annual increase, should be learnt and practised, as well as the methods for determining the normal annual yield of the forest. The next step would be to examine compartments of mature forest, where felling operations are to be commenced or are in course of progress. In these all that relates to the working of the timber and the regeneration of the forest, whether by self-sown seedlings or by planting, should be studied. Lastly, a series of compartments should be examined, representing the different ages of the forest growing under different conditions, from the young thicket to the nearly mature forest, and here special attention should be paid to the periodical thinnings. Should the district be composed of several working circles or classes of forest (Betriebsklasse, Betriebscomplex, Wirthschaftseinheit), then it will be necessary to go through each class in the same manner. The entire administration and management of the district should be studied—area, annual yield in material and money, the mode in which the operations of the year are regulated, the description of boundary marks, forest rights, roads and other means for the transport of timber, subordinate establishments, forest offences and mode of dealing with them, damage by storms, fire, or insects, sources of labour, prices of timber and other forest produce.

Importance of visiting one of the forest schools.

The thorough study of one forest district is, in my opinion, the first and indispensable step; this task cannot satisfactorily be accomplished under two months, and if possible a longer time should be devoted to it. A better foundation still would be laid if a similar course could be gone through successively in two or three forest districts presenting different features of soil, vegetation, and management. After completing this course, which stands in the place of a practical apprenticeship, the choice lies, in my opinion, between two plans, to visit a number of forest districts in other parts of Germany, or first to spend a term at one of the principal public forest schools, and then to travel, in order to see a greater variety of forest management. The latter course would require nine to ten months altogether, whereas the former could be accomplished in three to four months. The residence during a term at a forest school has many ad-

vantages. By attending a few of the principal courses of lectures and all excursions, by reading and private instruction, according to a regular plan which the director of the institution will be glad to arrange, a more connected knowledge of the principal branches of forestry will be attained than can under ordinary circumstances be acquired by the residence at forest districts. The personal intercourse with the director and professors at the institution, and with some of the more advanced students, cannot fail to be instructive in many respects, and an advantage of some importance is the chance of meeting young forest officers from other countries, Russia, Sweden, Italy, Spain, who will often be found attending the institution for the same purpose. At the close of the summer-time, in August or September, most forest schools make an annual forest journey of two or three weeks' duration under the guidance of the Director. This affords an excellent opportunity for seeing a series of instructive forest districts under the most competent guidance, of taking part in important discussions on professional subjects, and of making the acquaintance of forest officers of all grades, in their divisions and forest districts. Such an opportunity should be utilised if possible. I feel assured that those who may follow my advice in this respect will not regret it, but will agree with me in valuing highly the advantage of having taken part in one of these forest journeys. In Captain Walker's report the names of the principal German forest schools are mentioned, and it is needless for me to say anything more on the subject.

Experimental researches on the growth of forests.

Systematic experiments concerning the growth of forest vegetation and other matters connected with forestry have for some time past been instituted in Saxony, Prussia, and Bavaria, to a certain extent in connexion with the public forest schools of those countries. Thus, at Tharand, the durability of spruce timber felled in each month of the year, is now being tested, and at the same time the quantity of moisture, and the mechanical and physical qualities of timber felled in the different seasons is being determined. Again, there is a physiological laboratory at Tharand, where plants of different kinds are grown in water under the influence of various soluble substances, and these experiments have already yielded important results. In several forest districts plots of young forest have been fenced in, and are subjected each to a different treatment. In Bavaria extensive meteorological observations are being made, in order to determine the climatic requirements of the different forest trees, the influence of forests upon climate, upon

the temperature and moisture of the soil, and upon the formation of springs. In the Spessart systematic experiments have been commenced, in order to determine the effect of different systems of thinning, early and late, slight and strong, upon the annual production of wood on a given area; and besides these there are numerous other questions which it is contemplated to subject to a regular series of systematic experiments.

Classes of forest recommended for study.

Instead of recommending any particular forest districts, I will rather mention the principal classes of forest which should, as far as possible, be studied in detail. Of coppice woods, the oak coppice of western Germany, the Rhine, Moselle, and the Odenwald should be examined. Their management (generally on a rotation of 14 to 16 years) is simple, nevertheless much skill and thought has been brought to bear upon them. Of high timber forests I will first mention those of oak and beech mixed, which may be seen to perfection in the province of Hanover and in the Spessart hills in Franconia; they are maintained by self-sown seedlings, with the aid, particularly as regards the oak, of sowing and planting. The various means by which the development of the oak is favoured at the expense of the beech, but at the same time with its aid, should be noticed. On the Spessart special attention is invited to the difference between the central forest tracts, where the ground has always been under cover, and the outskirts, where the land has been so impoverished by pasture, the removal of dead leaves, and wasteful fellings, that it has become necessary to improve these tracts by extensive plantations of coniferous trees. The soil overlying the red sandstone of the Spessart is by no means rich in itself, it has however been improved by the accumulation of vegetable mould during ages of forest growth, and the results are these splendid pieces of sound oak timber, 60 feet long and more, with a diameter of 2 to 3 feet at the smaller end, which are produced in the Rothenbuch and other districts. The different requirements and mode of growth of the oak and beech will be found to be one of the most instructive features in this class of forests, and those cases where there are other trees, besides, such as maple, lime, and ash (the vicinity of Göttingen and Lauterberg on the Harz) should be studied with special attention. The oak and the ash will be found to possess certain points in common with the teak tree. Pure oak forests (generally of *Quercus pedunculata*) will be found on deep alluvial soil along the Elbe and other rivers. The rapid growth of the oak on rich soil should be noticed, and the high prices realised by its timber, not less and often

more than the close grained and slowly-grown timber of the Spessart.

Scotch fir forests.

In the plains of north-east Germany, Hanover, Brandenburg, Saxony, the extensive Scotch fir forests, which are mainly regenerated by sowing and planting, should be visited. Insects have been the great difficulty in many of these tracts, and in some cases an attempt has been made to revert to natural regeneration on that account. In the eastern provinces of Prussia forest fires have also been most destructive. The Scotch fir forests of Franconia (*Steigerwald, Hauptsmoor*, near *Bamberg*) are principally maintained by self-sown seedlings. In these forests the successful employment of an underwood of beech to improve the growth of the Scotch fir should be noticed. In the forest tracts round Kloster Ebrach will be seen the results of this system in the shape of magnificent stems, with dark red heartwood, which fetches a higher price than oak. A different sort of management may be studied in the sandy alluvial plains of Hesse-Darmstadt. The Forest crop (Scotch fir, and sometimes oak) is made to alternate with cereal crops. This remarkable system should be studied in the Grand Ducal Forest District of Viernheim, where it is in force on an area of 5,000 acres. The forest crop is cleared and rooted up, and the ground is then planted in lines with Scotch fir, on better soil mixed with oak (the Scotch firs acting as nurses to the oak), and potatoes are planted between the lines. The second year a crop of rye, and then two more crops of potatoes and rye are taken. In this manner the young plants are sheltered during the first four years of their existence, and the ground is kept clear of grass. Under the peculiar circumstances of the locality, deep but moist sand, much exposed to late frosts in spring, this system answers admirably, the growth of the trees is better than where no crops are taken off the ground (in the vicinity), and in addition there is a surplus from the agricultural part of the operations. Forest officers from Burma will be glad to see this system, which is analogous to what was introduced in 1864 in the teak plantations near Toungoo.

Spruce and silver fir.

Of other coniferous forests I will note specially the splendid spruce forests of the Harz, the Thüringer Wald, and Saxony, mixed here and there with Scotch and silver fir, and mostly regenerated by planting, and the silver fir and spruce forests of the Schwarzwald, in the kingdom of Wurtemberg and the Grand Duchy of Baden, mainly regenerated by self-sown seedlings. The great variety in the rocks and soils of this most instructive mountain range should be noticed. *Gneiss* prevails in the centre on the

west side, and is surrounded on three sides, viz., north, west, and south, by an irregular belt of *granite*, and these crystalline rocks are overlaid nearly all round by strata of *red sandstone*, so that in many places, for instance near Rippoldsau, the lower slopes of the valleys consist of *gnèiss* or *granite*, while the ridges, spurs, and the high table land between the valleys are composed of *sandstone*. Further east, towards the Valley of the Neckar, *muschelkalk* overlies the *red sandstone*. The comparative study of forest vegetation on those different descriptions of soil will be found most instructive. Three distinct systems of management may be studied on the Schwarzwald, each of which has its peculiar advantages according to the circumstances of the forest. In the Wurtemberg State forests the mature crop is removed by a regular series of successive cuttings, extending over a period of from 10 to 15 years, planting being resorted to whenever necessary. The result of this system is a strictly regular gradation of ages, and no forester will visit the districts in the vicinity of Freudenstadt, for instance, the magnificent forest of *Pfalzgrafenweiler*, without admiring the complete and uniform masses of all ages, from the youngest growth to the gigantic stems which this district produces. A different system is followed in many of the Baden State forests, and in a great portion of the forests on the estates of the Prince of Furstenberg. Here also the mature crop is removed by successive cuttings, but they extend over a much longer period, frequently from 30 to 40 years. The heavier and older timber which is not likely to increase much in value is taken out first, meanwhile the ground gets covered with young growth, mixed with groups of old timber, but still in full vigour; which having got sufficient side room, are increasing rapidly, and when these have attained good marketable dimensions, then they also are cut out successively, so that when the last of the old crop falls, a portion of the young forest has attained a considerable size. The result of this system is necessarily a forest of somewhat less regular character, but it is compact, and the inequality of age which is marked in the young growth gets much less conspicuous as the forest grows older. The third system consists in cutting out the oldest and heaviest timber from all parts of the forest, one compartment after the other being worked in regular rotation. This system (*Femel, or Plänterhieb*) is the only safe plan on steep slopes or on rocky ground, where the main object is to keep the ground covered as much as possible, and never to allow a blank, where the soil might get loosened and ravines or torrents formed. Cutting by selection is also the prevailing

system in many of the smaller private and communal forests of the Schwarzwald, and something intermediate between this and the second system is found in the large private forests in the Valley of the Murg near Gernsbach (Schifferschafts waldungen).

Different systems of management in the Black Forest.

The study of the comparative merits of these three systems will be found highly instructive, and discussions on this subject with the local forest officers will be found most interesting. The effect of storms upon compact masses where the trees have drawn each other up to great lengths, after cutting has commenced, is often extremely destructive, though less so with the silver fir than with the spruce, and experience has shown that forests of a more irregular character, where the old timber has grown up in isolated groups, have greater powers of resistance against wind and storms. On the other hand the irregular system has many drawbacks. Where the ages are well separated in different compartments, pasture can be permitted without any injury to the forest in the older blocks, but under the irregular system cattle must either be excluded entirely, or the young growth must suffer. It would lead too far were I here to enter fully into the merits of these different systems. They must be studied on the spot, with the aid of the working plan and of the statistical data showing the results of the working of each system in different forest districts.

Forest legislation in Wurtemberg and Baden.

Those who have time should, while in the Black Forest, make themselves acquainted with the difference in forest legislation and organisation of the forest service in both countries. The kingdom of Wurtemberg has no separate forest law, Baden on the other hand has a most elaborate, and as far as I am able to judge, efficient forest legislation. Special attention should be directed to the provisions which regulate the supervision of private forests, contained in the general forest law of 1833, and modified by the special law of 1854. In this respect forest legislation has in Baden gone further than in most other countries, and some of the provisions are almost as stringent as those of the forest law of the *Canton de Vaud* in Switzerland. Thus no forest can be rooted up without the sanction of the forest department, and no clearing is permitted without sufficient guarantee that the forest will be restocked, and if not restocked within a certain period, the work may be done by the forest department at the proprietor's expense. In the case of small detached forest property the guards who have the protection of the forest are appointed by the village community to which they belong, and their appointment requires the confirmation of the chief civil officer of the

district. These are only a few provisions of a law which deserves careful study, the more so, as it is in force in a country which has for a long series of years enjoyed truly liberal institutions.

Forest administration in Wurtemberg and Baden.

In the matter of forest administration it should be noticed that in Baden there is at Carlsruhe, the seat of the Grand Ducal Government, a board of councillors, presided over by a director, for the management of forests and other public domains. This board or council is subordinate to the minister of home affairs and the finance minister, to each in his own branch, but it has its own defined limits of authority, special matters only being referred to the ministry. Between this body and the district forest officer there is no intermediate authority; each district, however, is inspected periodically by one of the forest councillors. The entire country is divided into 110 forest districts, and most district forest officers have thus the supervision of communal and private woodlands in addition to the State forests under their charge. The question whether any land comes under the head of forest is settled once for all by the entry in the *Cataster* register. In Wurtemberg local inspecting officers, each in his division, are placed between the district forest officer and the central authority at Stuttgart. A remarkable institution of that country are the military forest guards. Non-commissioned officers are, as reward of good conduct, appointed forest guards (*Forst Wächter*), without, however, ceasing to belong to the military establishments. Each forest guard has charge of a subdivision of the district, he is employed to protect the forest and generally to assist the district forest officer in his subdivision, but in all matters of discipline he is subordinate to a superior military officer at Stuttgart, who is member of the Central Board (*Forst direction*).

Working of the forests.

Regarding the transport of wood and timber, and the impregnation of timber, the following remarks may be found acceptable; they are an extract of a report which I drew up on the subject in July 1872. In this respect also the Black Forest is one of the most instructive forest regions. The country is hilly, difficult, and large quantities of long and heavy logs are exported from it annually. The floating of timber has gradually diminished with the increase of railways, but on the rivers Kinzig and Nagold, and their tributaries, large timber is still floated to a considerable extent, and under arrangements which are extremely instructive. March and April are the best months to study the floating on these small rivulets,* the peculiarity being,

* Floating, however, often takes place during summer also.

that by storing up water in tanks and reservoirs, an artificial flood is produced which floats down the long narrow rafts, several hundred yards long, though the flood itself is not more than about twice the length of the raft. I do not know of any forest district in India where the same arrangements could be made; but circumstances regarding the carriage of timber are never the same in any two places. People who have studied the transport of timber in Europe will, when brought to India, see that they have only learnt how difficulties of a similar nature have been overcome under circumstances widely different.

Land transport in the Black Forest.

Three points are of special importance here in the land transport; first, the moving of the heavy logs down to the nearest road or slide; secondly, the construction of timber roads; thirdly, the use of these roads and of other lines as timber slides. In the Black Forest all fellings, as a rule, take place in summer, and the timber is being brought to the roads until autumn; but the construction of slides and the sliding down takes place in October and November. The locality most conveniently situated to study these matters is Rippoldsau, a small watering place situated in the midst of the well known forest belonging to the Prince of Fürstenberg, which is surrounded by other instructive forests belonging to Baden and Wurtemberg, partly State, partly communal forests. The system of timber roads in the Rippoldsau district is admirable. To study the system of land and water transport employed in the different forest districts of the Black Forest, it would be necessary to devote part of August, September, October, and November to it, and to visit during that time the following places, Rippoldsau, the valley of the Murg, St. Blasien in Baden, Freudenstadt, and Wildbad, in Wurtemberg. I do not know of any forests so extensive as the Black Forest where the moving of long and heavy timber over difficult ground by means of simple appliances is done in a manner equally efficient, economical, and with the same care for the young growth of the forest.

Wood transport in Bavaria.

In Bavaria two extensive forest tracts are specially important for the transport of timber. In the "Baierische Wald," which covers the hills north of the Danube between Passau and Regensburg, the arrangements made to facilitate the floating on the rivers Ilz and Regen and their tributaries are worth studying, and in the eastern Bavarian Alps (Salinenbezirk) both the land and water carriage of the wood required to feed the saltworks of Berchtesgaden, Reichenhall, Traunstein and Rosenheim is instructive. July and August are, I believe, the best months for these dis-

tricts. However, there is this drawback, that a small proportion only of the wood is timber; most of it consists of small pieces for burning. Nevertheless, a great deal that is suggestive for our Himalayan forests may be learnt in the Bavarian Alps.

In Austria, the most instructive arrangements for the transport of wood with which I am personally acquainted are those made to provide the large quicksilver works of Idria with wood for fuel. I visited them in 1865, and forest officers who have time to spare during their leave will do well to devote a week to their study. Idria is about 30 miles distant from Loitsch, the nearest station on the Trieste-Laibach railway. The wood is carried on temporary tramways, which are built with great care over most difficult ground, whenever fellings commence in any forest tract; and which are broken up, and the timbers which form the roadway and viaduct sent down, after they have served the purpose of carrying the yield of the forest tract felled to one of the small streams down which the wood is floated to the works. The dams and spurs constructed for storing up water in these streams, and for regulating their course, are as instructive as the system of these temporary timber tramways. Idria.

In the Italian (formerly Austrian) Alps north of Venice, the carriage of timber (not of firewood) offers much that is interesting and suggestive to Indian forest officers. The forests are the property of the Communes (towns and villages) in the valleys of the rivers Piave and Tagliamento and their feeders. The timber which is yielded by these forests is shipped at Trieste and Venice, and is an important source of supply for the countries in the eastern part of the Mediterranean. I visited these forests in 1865, and found that the lumberers of Friaul were extremely skilful in managing the land and water transport of their timber under exceedingly difficult circumstances. Temporary timber slides similar to the tramways of Idria, are built down the hill slopes, or on timber viaducts across ravines, and as the operations in one locality are completed, the timber composing these structures is sent down after the rest. Under Austrian rule, these forests were under efficient supervision, which was exercised by the Officers of the State Forest Department, and in consequence they yielded a steady annual revenue, from which the communities in those valleys built churches, school-houses, town-halls, and constructed a system of admirable roads. I have rarely been struck more forcibly by the beneficial effects of well managed communal property upon the well-being of the population of small towns Friaul.

and villages than in this instance, and on this account also a visit to these forests by Indian Forest Officers would be useful.

Tools used.

One of the main points to which the attention of Forest Officers visiting the localities mentioned should be directed is the use of the different sorts of levers and other tools which the lumberers employ. Some of these tools may merit imitation in India. The pick-lever (Krempe, Sapine) is one of the most important, and the different forms of it which are used in the Schwarzwald, the Bavarian Alps, Idria, and Friaul, should be carefully noted.

Impregnation of timber.

I now proceed to offer some suggestions regarding the study of the impregnation of timber. Of the numerous methods that have at various times been tried, there are, in my opinion, only two which are likely to meet our requirements in the Indian forests. The first is known as Boucherie's system. Timber, fresh felled, not dry, is impregnated with a solution of sulphate of copper, under a certain amount of hydrostatic pressure, the tanks being raised about 30 feet above the pieces to be impregnated. This method has been found to answer best for the impregnation of telegraph posts, and is largely used for that purpose in France and Austria. For various reasons, mainly because our forests are scattered over a large extent of country, and not sufficiently compact, this method does not appear to be as suitable in India as the following. The second is impregnation in air-tight cylinders. The wood, which is ready cut (sleepers, posts, planks, or other scantling), is dried completely, and then placed in the cylinders, which are first evacuated, so as to diminish the resistance which the air in the pores (tubes and vessels) would offer, after which the fluid is admitted, and forced into the wood under considerable pressure. The principal kinds of antiseptic fluids employed under this system are,—*creosote* (obtained by the distillation of coal tar), *chloride of zinc*, and *sulphate of copper*. Besides these substances, *corrosive sublimate* is used on some of the German railways (Nassau and Baden).

Antiseptic substances used.

Boucherie's process must be learnt in France or Austria, but the pneumatic process for creosote may be studied quite as well in England. Pneumatic apparatus for the impregnation of beams, railway sleepers, and other scantling with creosote are numerous. On the Continent, I may mention the following establishments, which are well worth seeing :—

Creosote.—Rheinische Eisenbahn, Nippes, near Cologne. I visited this establishment last year, and found the arrangements excellent, and most instructive.

Chloride of zinc.—Brunswic and Hildesheim, near Hanover.

I do not know these establishments myself, but understand that they are well worth a visit.

Sulphate of copper is still used in pneumatic apparatus (cylinders of copper) on some of the North German lines, but I have not yet been able to ascertain particulars regarding existing establishments. In 1865 it was also in use on the North Italian lines, the impregnating apparatus being at Verona.

Corrosive sublimate is used at the impregnating establishment of the Nassau lines at Limburg, not far from Coblenz. I regret that I have not had an opportunity of visiting this establishment, and I am not acquainted with the apparatus employed, but I have lately seen a report regarding the duration of sleepers impregnated with that substance on the Nassau lines, which appeared to be favourable.

In 1871 the following antiseptic substances were used by the lines of the Association of German Railways:—

Chloride of zinc on - -	22 lines.
Sulphate of copper on - -	19 „
Creosote on - - -	15 „
Corrosive sublimate on - -	14 „

In England creosote is the substance mainly used for the impregnation of railway sleepers.

German forest literature.

It may not be useless in conclusion to give a list of a few German books and periodicals on Forestry, which will be found useful. Of the periodicals, which are numerous, I will only mention *Heyer, Allgemeine Forst und Jagdzeitung* (monthly); *Tharander Forstliches Jahrbuch* (quarterly); *Baur, Monatschrift für das Forst- und Jagdwesen* (monthly); *Danckelmann Jahrbuch der Preussischen Forst- und Jagdgesetz gebung und Verwaltung* (annually). The proceedings at the periodical meetings of the general and local associations of foresters in Germany contain much that will be found instructive, and should officers find time to attend any of these meetings, they will not regret having done so.

As a general handbook I am inclined to name *Carl Fischbach, Lehrbuch der Forstwissenschaft;* for forest culture, *Burckhardt Saen und Pflanzen;* for plans of operations, *Judeich Die Forsteinrichtung.* For timber transport and working of forests the following: *Gayer, Forstbenutzung, 2nel edition, Aschaffenburg,* 1868, *Forstliche Mittheilungen des Königl. Baierischen Ministerial Forst Bureau Band III. Heft* 2, *München,* 1860. (Contains: *Artikel über Holz aufbereitung und Landtransport.*) *Buresch, Darstellung der verschiedenen Verfahrungsarten und Apparate welche zum Imprägniren d's Holzes Anwendung gefunden haben. Dresden,* 1860. Regarding forest legislation, *Roth, Handbuch des*

Forstrechts (with special reference to Bavaria). *Pfeil, Anleitung zur Ablsösung der Wald-Servituten.* Regarding forest statistics, *Leo, Forststatistik über Deutschland und Oesterreich-Ungarn.* A small spirited book by August Bernhardt, on the general question of the maintenance of forests, *Die Waldwirthschaft und der Waldschutz,* will be read with interest. *Die Forstverwaltung Bayerns* and *O. von Hagen, Die forstlichen Verhältnisse Preussens* are works of permanent value, which may serve as a model for similar publications in India.

Forest administration in Italy.

In conclusion I desire to draw attention to the recent development of forest matters in Italy. Shortly after the establishment of the present kingdom a central forest school was organised in the vicinity of Florence. The director is A. di Bérenger, formerly in the Austrian forest service of Venezia, and well known by his excellent work on the history of Forest management in Italy (*Archeologia Forestale, ossia dell' antica Storia e Giurisprudenza Forestale in Italia. Venezia,* 1863). The district assigned to the institution is the splendid silver fir forest of Vallombrosa, below the crest of the Apennines, on their western slope, about 20 miles east of Florence. During winter the school is transferred to a lower situation at Paterno, in the region of the Olive, half-way between Vallombrosa and the railway station of Pontassieve, in the valley of the Arno. A visit to Vallombrosa will be found pleasant and instructive, and forest officers who may come home from or return to India viâ Italy, will be glad thus to see something of forestry in that country. For the use of the students a collection of excellent memoirs * is being published by the director with the assistance of some of the professors, the first volume of which has just been completed containing an introduction on the climatic and general influence of forests, a brief historical account of Forest management in Germany, France, and Italy; two memoirs on the structure, nutrition, and cultivation of forest trees; and a paper on the valuation of forests and the preparation of working plans. This publication is to appear periodically in the form of a forest journal, and the first volume contains, besides the larger papers mentioned, various short notices on matters relating to forestry. Italian forest literature otherwise is not rich, but of late there has been a series of important and interesting official publications by the Ministry of Agriculture, which is entrusted with the direction of forest administration in Italy. The two most important of these are a collection of the laws and statutes relating to forests

* Raccolta di Memorie lette nel R. Istituto Forestale di Vallombrosa.

which have legal force in the different territories composing the kingdom, and a general statistical account of forest lands in Italy.* Of the last-named work the introductory part has been separately published in the Annals of the Ministry of Agriculture. Of a total area of 28½ million of hectares, inhabited by a population of 24¼ millions, five millions of hectares was in 1870 classed as forest land, made up as follows:—

State forests - - -	194,000 hectares.
Communal forests - -	2,170,000 „
Private forests - - -	2,662,000 „
Total - - -	5,026,000 hectares.

The large ecclesiastical estates which of late years have become public property, have not been retained as State forest, but have been sold, and a considerable portion of the Crown forest lands and other dominions of the different Italian territories, has also been alienated. This explains the small extent of State forests in the present Kingdom of Italy. The question of the forest lands in the Island of Sardinia, which are, or were until lately, the joint property of the State and communes, has not yet, I believe been finally settled, and to the extent of half a million of hectares they are entered under the head of communal forest lands.

Projects of general forest legislation.

Projects of a general forest law for the whole kingdom have repeatedly been submitted to the Italian Parliament. The evil effects of denudation are keenly felt in many parts of the country, and the aim of these proposed legislative enactments has hitherto been to guard against further mischief, by determining beforehand which lands shall, in the public interest, be clothed with forest or be kept under forest, and then to place the whole of these lands under the supervision or control of the public forest officers without distinction, whether they happen to be the property of the State, of village and other communities, or of private persons. From the report with which the Minister of Agriculture submitted a project of general forest law, in March 1870, it appears that the financial exigencies of the country had rendered imperative the alienation of the greater part of the forests at the disposal of the State, and that it was only intended to retain a limited area of State forests, mainly with the view of supplying the timber required by the Navy, and the forests required for this purpose the bill proposed to declare inalienable.

* Raccolta delle Leggi Forestali, 1866. Statistica Forestale, 1870. Some of the figures in the latter work are believed to be open to correction.

Thus, with regard to forest matters, it seems probable that Italy will pursue a policy different from that which has of late years been initiated in most provinces of India. In those provinces we acknowledge the necessity of maintaining certain areas under forest, or of clothing them with forest when they are bare, but we do not expect any satisfactory success in these attempts, unless the forests to be thus maintained or created are under the entire control of the State, and we entertain no serious hopes of effecting any real good by the supervision of private forests, or by any general kind of control over communal forests, unless the administration or management of such communal forests can be vested entirely in the hands of the public forest officers.

The general forest policy of Italy compared with that pursued in the provinces under the Government of India.

In those provinces, therefore, of the Indian Empire, to which I now refer, our principal aim is in the first instance to consolidate the State forests wherever the State has suitable forest land at its disposal, and we hope that eventually, when the majority of public forest officers shall have acquired that professional knowledge, skill, and experience which is necessary for a satisfactory management of forest lands, that they may be found competent, not only to manage the State forests entrusted to their charge, but also to induce large landed proprietors to follow their example in the management of their own estates, and if such should ever be found necessary and expedient to exercise an efficient supervision over private and communal forest lands; but we think that any attempt to exercise supervision and control over private and communal forest lands through the agency of forest officers who have not actually charge of public forests entirely under their control, and who cannot point to the management of their own forests as an example to be followed in the management of the private or communal forests, would lead to unsatisfactory results. The further development of the general forest policy in Italy will doubtless be followed with great interest by Indian foresters, and on this account it appeared to me right to add the present remarks.

The old State forests of the Venetian Republic

Besides the silver fir forest of Vallombrosa there are many other public forests of interest in Italy. A mere enumeration would be of little use, and a descriptive account would lead too far; it must suffice to state that any forest officers who may visit the communal forests of Friaul will do well to see some of the old forests of the Venetian republic, which in the middle ages and during the centuries immediately following, yielded a large portion of the timber required for the navy of that rich and powerful State. The oak forest of Montello, near Treviso, the mixed beech and silver fir forest of Cansiglio on the limestone hills north of

Ceneda, are some of the old State forests of Venice, and the boundary marks of the republic cut in the live rock were shown to me eight years ago on the south-east limit of the Cansiglio forest. High up on a tributary of the Piave, near the small town of Auronzo, is the Sommadida forest, of limited extent, but on deep rich soil, and with exceedingly luxuriant growth of spruce, larch, and other trees. The larch is here in its native home, and I have never seen finer specimens, both as regards length of stem and quality of the wood. The mast pieces for the Venetian Navy were partly brought from this forest. I understand that it is not intended to alienate Sommadida, which I fear may be the case with many of the other old Venetian State forests. Mast pieces for the dockyard at Venice, however, were in 1865 brought at less cost by rail from the forests of Galicia than down the Piave from Sommadida. Such has been the effect of railways upon timber trade. The wine casks for Hock and Moselle are no longer exclusively made of oak from the Spessart or the forests near the Rhine, for the oak imported by rail from Hungary and Dalmatia at present undersells the home grown timber, and similar changes and fluctuations will from time to time be experienced in India. So much, however, is certain, that the demand in India for timber, bamboos, wood, fuel, and charcoal, whether for export, for building, or for the use of steamers, railways, or ironworks, is not likely to decrease, but is certain to increase steadily. Nor is the law that an increased demand will always produce an increased supply, likely to hold good in the case of a timber crop, which requires 100 years or more to attain maturity. The formation and consolidation of public forests, therefore, managed by State forest officers, which has for some time been progressing in most provinces against much opposition, will eventually be recognised as a source of prosperity and comfort by the manufacturing, trading, and agricultural population of India.

D. BRANDIS.

NOTES.

p. 166. *Forest Management in Switzerland.*—Forest officers, who have had the privilege of serving in the Himalaya will find much of special interest in the Swiss Alps. The system of management in the Bavarian Alps, it is true, is more perfect throughout, but in Switzerland the difficulties in the way of forest conservancy have been much greater, and offer many points of analogy with those obstacles which impede progress in our Himalayan forests. There is no lack of forest rules and

forest laws in Switzerland; indeed, in several cantons the existing laws prescribe a strict and detailed supervision over the management of forests, not only of villages, associations, and other public bodies, but also of private proprietors. And in some cantons, for instance, Bern and Zürich, the forest laws are fairly and strictly carried out; in others, however, they are nearly a dead letter, and in some there is no forest legislation at all. The greatest difficulty of all is the unregulated pastures of cattle and goats throughout the forests. The evil consequences of this state of things has long been felt keenly by many public spirited men, and the *Swiss Association of Foresters* has during the last 30 years unceasingly urged this matter upon the attention of the public, the governments of cantons, and the Federal Government. In 1858 the matter was at last taken up by the Federal Council, and a resolution was passed to institute a regular and systematic inquiry into the state of the Alpine forests. This inquiry was entrusted to a Commission, consisting of two engineers, one geologist, and one forest officer, the head of forest administration in the canton of Zürich, Oberforstmeister Landolt. The result of their labours, which occupied them during three years, are laid down in an excellent report, published at Bern in 1862. Proposals for a national forest legislation for the whole country have since that time repeatedly been made in the Federal Council, and the question will no doubt eventually be settled in a satisfactory manner. Meanwhile a good deal is being done through the exertions of the *Association of Foresters* and by the forest officers of certain cantons, particularly of Bern and Zürich, for the maintenance and improvement of existing forests, for the replanting of barren hills, and the fixing of loose soil on the sides and in the beds of valleys, ravines, and torrents. Those who may desire to study the forest question in Switzerland will find further details and useful hints in an article by Dr. von Berg, entitled "*Die forstlichen Verhältnisse der Schweiz,*" which appeared in 1868 in the 18th volume of the *Tharander Forstliches Jahrbuch.*

p. 170. *Beech Woods of Buckinghamshire.*—From an interesting paper on these woods and on cognate forest matters, published in the *Transactions of the Institution of Surveyors,* session 1872–73, vol. V., p. 189, I gather that the consumption of beech timber for the chair trade in the town and neighbourhood of High Wycombe, and the manufacture of wooden ware and turnery in and around Chesham is estimated at 10,100 loads (of 50 ft.) annually at High Wycombe, and 2,900 loads in Chesham, that the annual cuttings are now sold at the rate of from 1*s.* to 1*s.* 6*d.* per cubic foot of beech timber, and that over large extents of this wood the regular annual thinnings have of late years realized as much as 1*l.* per acre. In some of these woods visited by me last year the yield was stated to be much less, amounting to about 10–12 cubic feet per acre annually, realizing about 10*s.*

p. 171. *Windsor Great Park and Forest.*—These splendid woods are particularly instructive, because their history has been carefully studied. The results of these researches are recorded in a large work by Mr. William Menzies, the Deputy Surveyor of the Park and Forest, entitled *The History of Windsor Great Park and Windsor Forest,* 1864. Iron pillars with the dates of planting have been put up in the park at each plantation, and a table at the end of the book gives a list of plantations with their acreage, the number, average size, and cubical contents of trees per acre (in 1862). A copy of this table, or an extract will be found a most useful guide in visiting the different plantations. The oldest plantation (or rather sowing of acorns) dates back as far as 1580; its extent is 13 acres, and apart from the annual rings the historical evidence, given on page 3 of Mr. Menzies' work, seems to show con-

clusively that this plot was sown in the 22nd year of Queen Elizabeth's reign. Mr. Menzies adds that this is the oldest authenticated regular plantation in England. It may interest some to know that in Germany the earliest attempts at forming new forests and regenerating existing forests by sowing and planting on a large scale was made in the 14th century. (Scotch fir, near Nürnberg in 1368; plantations near Görlitz (Lausitz) before 1329; *see* Leo, in *Monatschrift für des Forst- und Jagdwesen*, 1871, p, 78; and Dr. von Berg, *Geschichte der Deutschen Wälder*, 1871, p. 351.) Most instructive and at the same time picturesque are the old trees of beach and oak, the remains of the original natural forest, now mostly planted up with oak. The planting of the magnificent avenue of elms, called the Long Walk, goes back to 1680, and there are large specimens of the *Pinus pinaster*, and splendid groups of the Lebanon Cedar, with tall clean stems, like the Deodar in the Himalaya, in the Belvidere district, planted about 1760. There is thus ample material for studying the growth of both indigenous and exotic trees. Of the latter, I would particularly draw attention to the Spanish chestnut, planted extensively, chiefly mixed with oak, since the close of the 17th century. The chestnut here grows more rapidly than the oak, and attains a larger size in the same time, but when old, the wood is often unsound. The principal formation of the Great Park is the London clay, resting on plastic clay, but the elevated points are capped with strata of Bagshot sand, often of considerable extent. This mixture of clay and sand produces a considerable variety of soils, with a marked effect on the arborescent vegetation. In Windsor Forest, oak is the principal tree, where the clay is the chief formation, and there are several thousand acres of oak plantations, which were made between 1817 and 1825. The southern part, however, where the Bagshot sand prevails, and the adjoining Sandhurst woods, are mainly stocked with Scotch fir. The vicinity to Windsor Park of the Indian Civil Engineering College, at Cooper's Hill, is a circumstance which forest officers on leave might well take advantage of, by fixing their residence for a time in the vicinity of Egham, attending some of the public lectures delivered at the College, and possibly, if leave can be obtained, the surveying, drawing, and some of the other classes.

p. 174. *Forest Administration in France.*—This has hitherto been under the control of the Finance Ministry, but proposals have repeatedly been made, and with particular force in December last, to the National Assembly, for its transfer to the Ministry of Agriculture and Commerce, on the ground that the administration of the public forests ought to be guided, not so much by the desire of deriving from them the greatest possible amount of present revenue, but by a due regard for the future welfare of the country in the matter of maintaining and increasing the supply of wood and timber, and of protecting the mountainous parts of France against the evil effects of denudation. The report on this subject by the Special Commission of the Assembly, which appeared in the *Journal Officiel de la Republique Francais*, of 30th December 1872 and 9th January 1873, contains much interesting statistical information, and an analysis of the financial results of several large sales of State forest property effected since 1860. According to that report, the present forest area of France (in round numbers) stands as follows:—

State forests - - -	900,000	hectares.
Communal forests - -	2,000,000	„
Private forests - - -	6,000,000	„
Total -	8,900,000	„

p. 196. *Forests in the Italian Provinces of Treviso, Belluno, and Udine* —The *Cansiglio* Forest occupies an elevated undulating plateau where the boundaries of the three provinces meet, but the largest portion is in the province of Belluno, area 7,245 hectares, of which 5,378 are stocked with forest, partly beech pure, partly beech mixed with spruce and silver fir, the remainder being pasture land. A portion of the beech timber is worked up on the spot by sieve makers, who purchase the tallest and cleanest stems to split them up into thin flexible planks, of which grain sieves and similar articles are made. The residence of the forest inspector in charge is, or was until lately, Vittorio, in the province of Treviso. *Montello*, on low hills near the Piave river, between Ciano and Nervesa district of Montebelluna, province Treviso, mainly consists of oak, its area is 6,230 hectares. The residence of the inspector in charge is (or was until lately) Giavera, and is to be transferred to Treviso. *Sommadida* district Auronzo, province Belluno, area 1,586 hectares, of which, however, 382 hectares only are stocked with forest.

These are the principal State forests in these provinces, the Communal forests mentioned on page 191 are situated in the following districts; they are mainly stocked with spruce:—

		Communal.	Private Forests.
Province Belluno,	Pieve di Cadore -	11,724 hect.	2,043 hect.
	Auronzo - -	20,516 „	1,680 „
„ Udine,	Tolmezzo - -	26,751 „	12,387 „
	Ampezzo - -	19,238 „	3,956 „

The inspectors who exercise the general control over these forests reside at Belluno and Udine. The best season to visit them is during May and June, when the lumber work is in full swing. The yield of these forests is stated to be 400,000 logs annually. The floating down the Piave river is facilitated by storing up water in a large reservoir near Dosoledo, in the parish of Comelico Superiore (district Auronzo), and lower down the river, at Perarolo, there is a large permanent rake across the river, by which the logs are caught before being rafted.

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